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JOURNAL OF DAIRY SCIENCE

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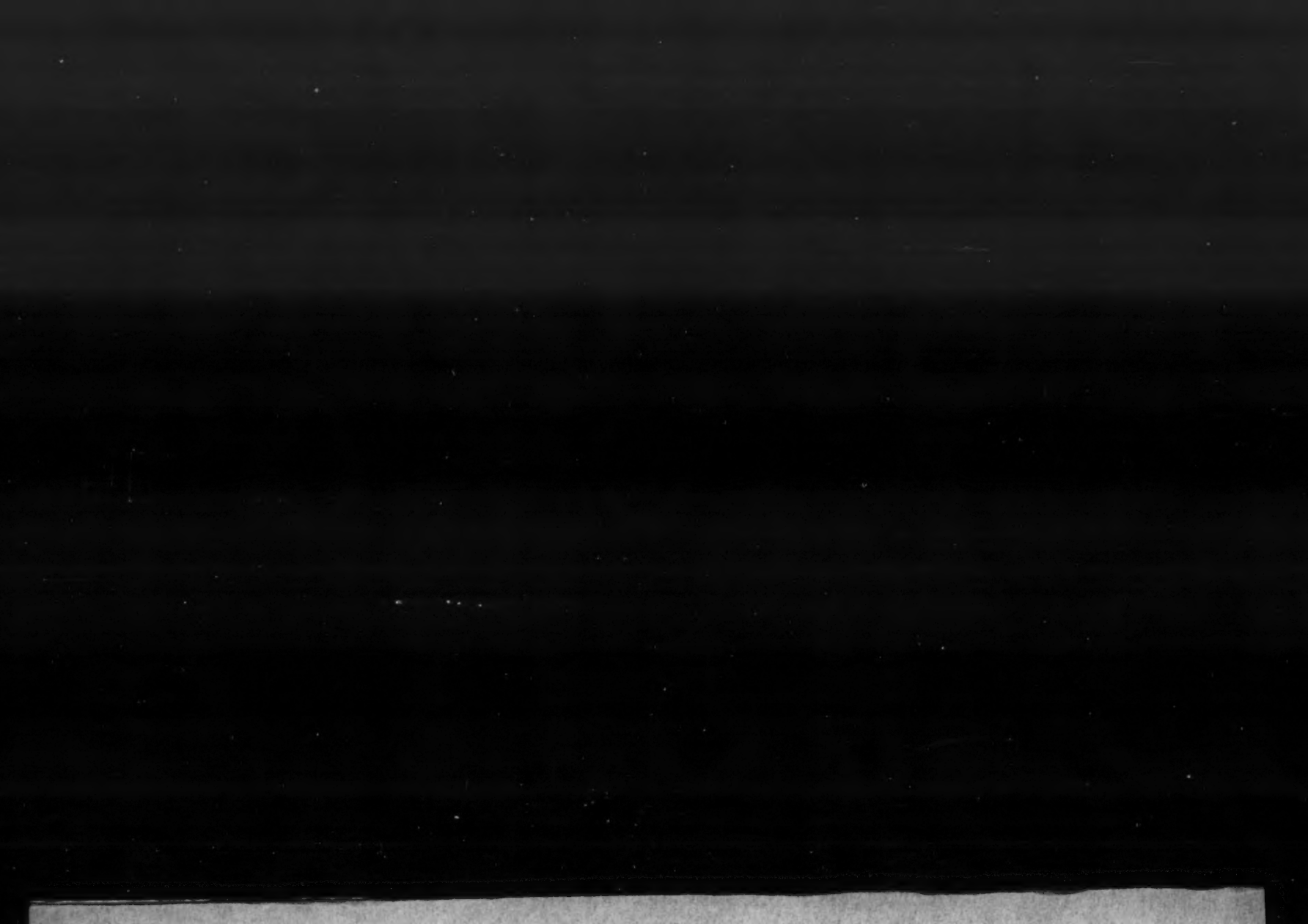

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The Journal of Dairy Science is issued monthly. Subscription is by the volume and one volume is issued per year.

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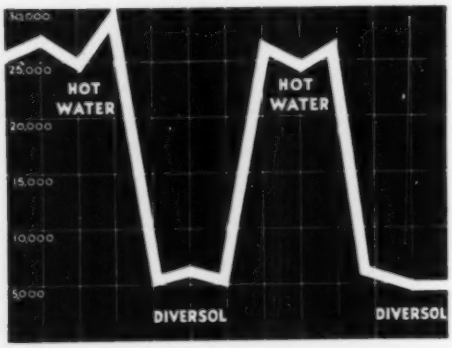

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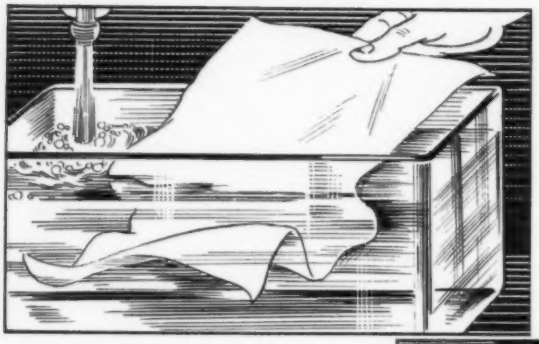

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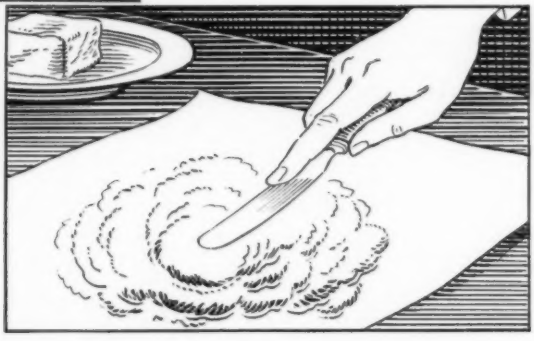

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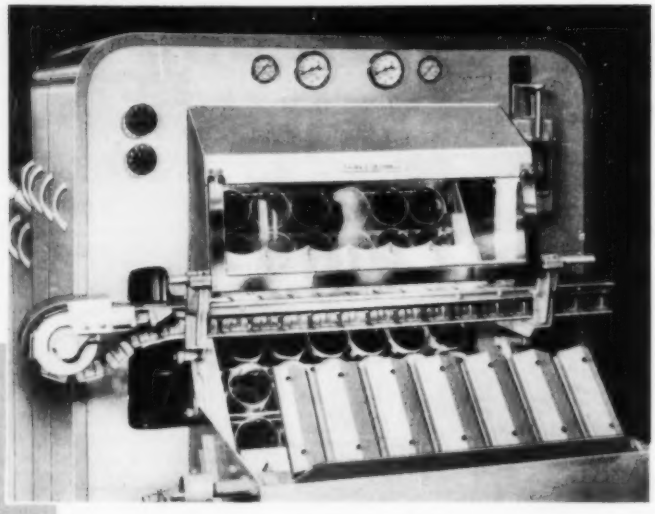

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JOURNAL OF DAIRY SCIENCE

VOLUME XXII AUGUST, 1939 NUMBER 8

A COMPARISON OF THE VITAMIN A POTENCY AND CAROTENE CONTENT OF DIFFERENT TYPES OF SILAGE[1]

M. WIGHT TAYLOR,[2] WALTER C. RUSSELL[2] AND C. B. BENDER[3]
New Jersey Agricultural Experiment Station, New Brunswick, New Jersey

The importance of vitamin A in the ration of the dairy cow has become increasingly evident in recent years and numerous assays have been made of the constituents of the ration. Feeding practices have changed in that prominence is being given to the use of artificially dehydrated hays and new types of silage instead of field cured hays, and consequently many studies have been carried out to determine the effect of these types of processing upon the vitamin A content of the crops. In much of this work a determination of the carotene content has been the method of assay since it has been shown that carotene is the main source of vitamin A in the feeding materials used.

REVIEW OF LITERATURE

It has been found in this laboratory (10) as well as in others (3, 6, 11) that the carotene content of the silage is often markedly higher than that of the fresh green plants from which the silage was prepared. However, no adequate explanation of this anomaly has been given. Peterson and coworkers (6) have advanced the theory that the action of acids which are present in silage, particularly in that prepared by the A.I.V. process, tended in some way to make the carotene present more readily extractable. Kane, Wiseman, Hartman and Cary (2) have reported that the acids present caused the formation, probably from xanthophyll, of a pigment which could not be readily separated from carotene by the usual partition methods, and which rendered inaccurate the spectrophotometric determination of carotene. In a recent investigation, Shinn, Kane, Wiseman and Cary (9) tested carotene extracts from fresh crops, hays, and silages. They found that, particularly in the last two materials, the carotene extract might contain from 20 to 40 per cent of a pigment which was not carotene.

Received for publication February 20, 1939.

[1] Journal Series paper of the New Jersey Agricultural Experiment Station, Departments of Agricultural Biochemistry and Dairy Husbandry. Presented before the Division of Biological Chemistry of the American Chemical Society at Rochester, N. Y., September, 1937.

[2] Department of Agricultural Biochemistry.

[3] Department of Dairy Husbandry.

After the present work was completed, Quackenbush, Steenbock and Peterson (7) showed the presence of 5 new carotenoids in the extract from acidified alfalfa and from alfalfa silage. Three of these pigments are not differentiated from carotene by the usual methods of analysis and will cause false high values. A recent work by Wiseman, Kane, Shinn, and Cary (11) summarizes much of their work on hays and silages and states that the error from pigmented impurities varied from 11 to 32 per cent in the case of the hays and corn silage.

The question arose, therefore, whether the colorimetric determination of carotene is an accurate measure of the vitamin A potency of silages. In order to answer this question, samples of silage, representing several crops and preserved by different ensiling processes, were obtained; the carotene contents of each determined colorimetrically; and the vitamin A potency measured by biological assay. It was thought that, if some change did occur in the carotene fraction during ensiling and storage, this change might be greater in some samples than in others.

EXPERIMENTAL

In obtaining the silages, no attempt was made to sample the contents from any particular silo, but the material chosen was always of good quality and reasonably representative of that crop. All of the materials tested had been preserved in the usual tower type of silo. In each case, about 25 lbs. of silage was obtained, ground through a motor driven meat chopper, mixed thoroughly, and stored in tightly stoppered bottles in a refrigerator at $0° \pm 5°$ C. Most of the samples showed no signs of molding or other spoilage, but in the few cases where this did occur they were immediately discarded. Carotene analyses were made at the beginning, the end, and approximately the middle of the assay period according to the method of Russell, Taylor and Chichester (8), and each sample was fed to groups of 13 to 15 vitamin A deficient rats at a level calculated to furnish 1.0 microgram of carotene per day. The assay method was essentially that recommended by the U. S. Pharmacopoeia, using the four week assay period. Although only a single level of each silage was fed, because of the larger number of animals, the average responses are believed to have more significance than would be the case with the usual group of 10 animals. Because of the small amounts of relatively coarse material which were required daily, double supplements were administered on alternate days.

The materials were stored and fed in the wet condition, since previous work had shown that a rapid destruction of carotene occurred during drying and storage in vacuo (10), whereas the carotene in wet silage was fairly stable. However, not all of the samples used in the present experiment were found to have such stability with respect to their carotene contents. It had been planned to change the feeding level to correct any change in the caro-

tene content, but this practice did not prove feasible because of the time required in running the analyses. Therefore, the animals were fed at the original level of silage throughout the assays and the average carotene intakes were calculated from the results of the colorimetric determinations.

RESULTS AND DISCUSSION

The results of the carotene analyses are shown in Table 1. The storage

TABLE 1

Carotene content of silages

Material	Initial carotene content	First storage period	Carotene content end of first storage period	Second storage period	Carotene content end of second storage period	Average[1] carotene content
	microgm. per gm.	*days*	*microgm. per gm.*	*days*	*microgm. per gm.*	*microgm. per gm.*
Regular corn silage #1	19.3	19	16.3	22	20.3	18.1
Regular corn silage #2	9.0	27	(17.8)	22	6.4	7.7
Molasses corn silage	15.9	21	11.8	30	11.8	12.6
Molasses oats silage	10.3	27	7.6	22	6.4	8.1
Molasses soybean silage	16.8	39	9.2	8	6.6	12.1
Molasses grass silage	28.4	21	25.7	22	23.1	25.7
A.I.V. soybean corn silage	26.1	49	25.8	8	33.2	26.4
A.I.V. alfalfa silage	25.4	21	13.6	30	8.8	14.6
A.I.V. corn silage (2 years old)	7.1	.....	.....	51	7.1	7.1

[1] Weighted average.

periods shown represent the time which elapsed between the 1st and 2nd, and the 2nd and 3rd analyses, which cover the total period of the bioassay in each case. The final column, which shows the average carotene content, has been weighted according to the number of days which elapsed between analyses. One value, shown in parentheses, was not used in the final average because it was badly out of line and believed to be in error.

Perhaps the most significant fact to be derived from these figures is that the samples varied rather widely with respect to the stability of the carotene. In certain cases the behavior appeared somewhat erratic with small losses or gains. These differences are believed to be due mainly to the difficulty of adequately sampling such heterogeneous material. In general, there was a loss of carotene during storage, this loss being most pronounced with the A.I.V. alfalfa and the molasses soybean silages. However, in no case was the loss as rapid as that which occurred when silage was dried at room temperature in a vacuum desiccator over sulfuric acid and stored in vacuo at $0° \pm 5°$ C. The figures emphasize the fact that the vitamin content of a test material

may change during the assay period so that the results may be subject to errors.

The levels of carotene present are not intended to represent the exact levels which may be expected in the crops described since no particular attempt was made to secure representative samples. It is of interest to note that one crop, corn, gave values ranging from 7.7 to 18.1 micrograms of carotene per gram of silage. It seems probable that similar variations might be found with different samples of the other crops.

The results of the bioassays are shown in Table 2. All the assays except

TABLE 2

Vitamin A content of silages

Material	Daily supplement of wet silage	Average carotene content of supplement	Average growth response	Vitamin A in supplement	Vitamin A per 0.6 microgm. of carotene
	mg.	*microgm.*	*gm.*	*U.S.P. units*	*U.S.P. units*
A.I.V. corn silage (2 yrs. old	140.0	0.98	41.8 ± 2.3	3.80	2.33
A.I.V. alfalfa silage	39.4	0.56	12.7 ± 2.3	2.03	2.18
Molasses corn silage	62.7	0.79	25.4 ± 2.2	2.66	2.02
Regular corn silage #1	51.0	0.93	28.5 ± 2.9	2.85	1.84
A.I.V. soybean-corn silage	42.7	1.13	36.8 ± 2.1	3.42	1.82
Regular corn silage #2	110.0	0.86	24.2 ± 3.3	2.57	1.79
Molasses oats silage	98.0	0.79	20.4 ± 1.8	2.36	1.79
Molasses grass silage	35.2	0.90	20.5 ± 1.6	2.38	1.59
Molasses soybean silage	59.6	0.72	10.4 ± 1.9	1.90	1.58
International standard carotene	[a]	1.20	32.6 ± 2.1	3.13	1.57

[a] Fed in 0.1 ml. of corn oil.

that on the A.I.V. corn silage were run on a single large group of animals and the results should therefore be strictly comparable. The A.I.V. corn silage was not available at the same time as the other samples and had to be assayed at a later date. The molasses soybean and A.I.V. alfalfa silages, which in Table 1 showed the greatest loss of carotene, and therefore were fed at the lowest levels of carotene intake, gave low average growth responses. In this colony such a rate of growth is too low to give reliable results. Therefore, the most reliable values may be considered to be those of the regular corn Nos. 1 and 2, molasses corn, molasses oats, molasses grass, and A.I.V. soybean-corn silages.

In Table 2, the next to the last column shows the vitamin A content, in U.S.P. units, of the supplement fed. These values were obtained by reference to a growth-response-dosage curve for the U.S.P. reference cod liver oil. In order to compare the different supplements on a uniform basis, values were calculated which show the number of U.S.P. units per 0.6 micro-

gram of carotene in the supplement. This figure was chosen as a basis for comparison since it is the value of the International Unit of vitamin A. The figures in the last column therefore show the ratios of U.S.P. units of vitamin A, as determined by biological assay, to International Units of carotene, determined colorimetrically.

An examination of these values shows, on the whole, good agreement, with the variation among the different groups probably being little more than may be expected in this type of work. If all the values are used the average is 1.88 ± 0.06 with a coefficient of variation of 13 per cent. If the 2 year old A.I.V. corn silage is not considered, since the data on this sample were obtained with a different group of rats, the average is 1.83 ± 0.05 with a coefficient of variation of 10 per cent. And if the results on the molasses soybean and A.I.V. alfalfa silages, which are considered less reliable because of the low growth response, are also dropped the values become 1.81 ± 0.04 and 7 per cent. All these averages are in close agreement and it may be concluded that one International Unit of carotene is equivalent to 1.8 U.S.P. units of vitamin A, or that 1 microgram of carotene is equivalent to 3 U.S.P. units.

The U. S. Pharmacopoeia Unit of vitamin A is considered to be biologically equivalent to the International Unit of carotene and the reference cod liver oil has been thus standardized. However, the growth responses from the feeding of the various silages, when translated into U.S.P. units by means of the growth-response-dosage curve for the reference oil, gave values ranging from 1.58 to 2.33 U.S.P. units per International Unit of carotene fed. Furthermore, a sample of the International Standard Carotene Preparation, fed at a single level, gave a growth response equivalent to 1.57 U.S.P. units per 0.6 microgram (1 International Unit) of carotene. The fact that all these supplements showed a relatively high potency in terms of U.S.P. units would seem to indicate that the carotene analyses have not given values which were too high, due to the inclusion in the carotene fraction of pigments not having provitamin A properties. These results are at variance with what might be expected on the basis of the work of Shinn and coworkers (9, 11) and of Quackenbush and associates (7). The reason is not known. It may be that the samples of reference cod liver oil used in preparing the dosage-growth-response curve were below the stated potency. To some extent the high results may be due to the natural variations which may be found to occur among groups of experimental animals. Munsell (5), for example, has reported that, over a period of 1 year, 8 groups of rats receiving identical vitamin A supplements in the form of the U.S.P. reference cod liver oil showed average growth responses in 5 weeks ranging from 16.4 to 33.5 grams. It is also possible that these differences can be explained by the work of Dyer, Key and Coward (1) and of Lathbury and Greenwood (4) which showed that different oils or even different lots of the same kind of oil, when used as diluents for vitamin A supplements, may influence the results.

The results obtained on feeding the A.I.V. corn silage are of particular interest in view of the purpose of this work. This material had remained in the silo for a period of approximately 18 months instead of the usual period of 6 to 10 months; furthermore, it was acid-treated silage. Consequently, if acid could cause the formation of pigments which would markedly raise the apparent carotene content, one might expect a correspondingly low biological value per unit of carotene fed. However, just the opposite was found to be the case. The ratio of U.S.P. to International Units, 2.33, was higher for this sample than was the case with any of the other silages, even though levels of reference cod liver oil fed at the same time as the A.I.V. corn silage gave less growth than did similar feedings made while the remainder of the assays were being run. This fact, as well as the fact that all of the other silages gave a higher growth response per unit of carotene than did the International Standard carotene, is believed to be further evidence that the formation of new carotenoids by the action of acid on green plant tissue does not interfere with the accuracy of the colorimeteric carotene determination as a measure of vitamin A potency of silages.

SUMMARY

Carotene analyses and vitamin A bioassays have been carried out on 9 samples of silage, including regular corn silage, crops ensiled with molasses, and by the A.I.V. procedure. In every case the bioassays showed a higher vitamin A potency per unit of carotene than was obtained on a sample of International Standard Carotene, but the differences were of such magnitude that the carotene analysis may be taken as a reliable index of vitamin A potency. One International Unit (0.6 microgm.) of carotene in silage was found to be equivalent to 1.8 U.S.P. units of vitamin A.

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THE VITAMIN D OF ALFALFA AND PRAIRIE HAY AND ITS UTILIZATION BY DAIRY COWS

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Several studies, such as those of Steenbock, Hart, Elvehjem, and Kletzien (12), Russell (9), Smith and Briggs (11), Bechdel, Landsburg and Hill (2), Huffman, Duncan, and Lightfoot (5), and Wallis, Palmer and Gullickson (14) have been reported in the last few years which show that most of the common roughages contain a certain amount of vitamin D. In general, these studies have been only qualitative showing particularly that the amount of vitamin D contained varies with the curing history, especially with the amount of exposure to sunshine during the curing process. They have also demonstrated that the vitamin D of roughages is an important factor in the prevention of vitamin D deficiency disturbances in calves and young stock during seasons of the year when such troubles are most likely to occur.

The importance in the human dietary of the vitamin D content of milk has been recognized for some time, but studies of the relationship of the vitamin D content of normal feeding-stuffs to the potency of the milk produced and the possibility of increasing the potency of the bulk of our country's milk supply by proper feeding and management have been overshadowed by studies of methods designed to enhance the potency to levels much higher than those obtainable by ordinary means. Hess, Light, Frey, and Gross (4), Light, Wilson, and Frey (8), and Russell, Wilcox, Waddell, and Wilson (10) have shown that when relatively large amounts of vitamin D are fed to cows in the form of special concentrates about 2 to 3 per cent is recovered in the milk. Such milk is potent enough to protect babies from rickets when fed in customary amounts. The value of such information is quite evident. The present investigation, however, includes quantitative studies of the vitamin D content of two common roughages, alfalfa hay and prairie hay, and some observations concerning its utilization by dairy cows for meeting body needs and enhancing the vitamin D content of the milk produced.

METHODS

A sufficient amount of alfalfa hay and prairie hay was obtained from local sources at one time to complete the entire experiment. Care was taken to secure hay of good, average quality and of comparable curing history. A representative sample of each lot of hay was secured at the beginning of the experiment and another one at the close to be used for a vitamin D assay.

Received for publication February 24, 1939.

Six grade Holstein cows were used. All the cows had freshened in the late summer and fall and on December 15 they were placed in the experimental barn and kept out of direct sunshine until the close of the experiment. In good weather they obtained exercise after dark in a dry lot. An attempt was made to bring any excess body reserves of vitamin D to a comparable basis by feeding all animals a vitamin D-deficient ration for two months. Molasses beet pulp, which contained no measurable amount of vitamin D, was used as the only roughage material. A grain mixture to balance the ration was made up of ground yellow corn, ground oats, corn gluten meal, common salt, and a little bone meal. A vitamin A concentrate was fed to avoid a deficiency of this factor.

On February 15, after two months under the vitamin D-deficient schedule, the cows were divided into three groups of two animals each. Each animal in group 1 received twenty pounds of alfalfa hay daily in place of the molasses beet pulp and the grain mixture for this group was changed to one of equal parts of ground corn and oats. Each animal in group 2 was given twenty pounds of prairie hay in place of the beet pulp. Two animals were continued on the molasses beet pulp ration as a control group.

Just before the cows were divided into groups on February 15, a sample of butterfat was obtained from the mixed milk of all six cows for vitamin D assay to establish the potency of the milk at the time the roughage feeding started. The cream obtained from separating this milk was churned, the butter was melted and the pure butter oil filtered off, placed in a glass jar, sealed, and stored in a refrigerator until assayed. After starting the alfalfa and prairie hay feeding, butterfat samples for vitamin D assay were secured at monthly intervals from each of the three groups of cows for a period of three months.

The regular line-test technique was used in making the vitamin D assays of the hay and butterfat samples. Litter-mate rats were spread as evenly as possible over the different levels of feeding for the test materials and International Standard Solution of Irradiated Ergosterol which was used as a reference oil. The designated amount of a test material was mixed with sufficient rachitogenic diet to make a total of 40 grams. This was usually consumed in the first seven or eight days of the test period. The rachitogenic diet only was given during the remaining days of the test period.

An attempt was made to use the method of concentrating the vitamin D of butterfat reported by Bechdel and Hoppert (3) to facilitate the assaying of the less potent samples. In checking the adequacy of the method it was found that the vitamin D was not being quantitatively recovered in the alcoholic extract. The method was modified chiefly by subjecting the alcohol-fat mixture to a one hour digestion period, under a reflux condenser each time before recovering the alcoholic extract, but the results were still unsatisfactory. A brief report of these attempts is included in this paper.

RESULTS

The essential data relative to the vitamin D assays on the alfalfa hay, prairie hay, and molasses beet pulp are presented in Table 1. There was no

TABLE 1

The vitamin D content of alfalfa hay, prairie hay, and molasses beet pulp

Material	Number of rats	Average healing*	Vitamin D per gram
			*I.U.***
Alfalfa hay			1.10
4.5 gm. sampled at beginning	8	0.43 +	
4.5 " " " end	11	0.55 +	
5 I.U.—Standard Reference Oil	11	0.57 +	
Prairie hay			0.55
9 gm. sampled at beginning	7	0.70 +	
9 " " " end	12	0.90 +	
5 I.U.—Standard Reference Oil	12	0.96 +	
Molasses beet pulp			.....
15 gm.	12	0.00	

* A narrow continuous line of mineral deposition is evaluated as a 1.0 + healing.
** I.U. = International unit of vitamin D.

significant difference in the healing response shown by the group of rats receiving 4.5 grams of the sample of alfalfa hay collected in the fall when the hay was put into the mow at the start of the experiment, and the group receiving 4.5 grams from the sample collected near the end of the experiment. Likewise, the healing by these two groups of rats on the test material is essentially the same as that shown by the Standard Reference group receiving 5 International units of vitamin D. On this basis 1 gram of the alfalfa hay contained 1.10 International units of vitamin D. The 12 rats receiving 9 grams of the sample of prairie hay collected near the end of the experiment showed practically the same healing as 12 litter mates that received 5 International units of vitamin D, indicating a potency of 0.55 International units per gram of prairie hay. The smaller group of rats used on the prairie hay sample collected in the fall shows slightly less healing but this is more likely due to differences in individual responses for this smaller group of rats, some of which were not litter mates, than to any significant change in the potency of the hay. Vitamin D could not be detected in the molasses beet pulp even when it was tested at a 15 gram level.

The results of the vitamin D assays on the butterfat samples are shown in Table 2. The butterfat produced by the cows in group 1 showed a steady increase in potency from 0.19 International units per gram at the start to 0.46 International units at the end of three months. These cows received 10,000 International units of vitamin D daily in the 20 pounds of alfalfa hay fed. The butterfat produced by group 2 receiving 5000 International

TABLE 2

The effect of the vitamin D ingested from alfalfa hay and prairie hay on the potency of the butterfat produced by dairy cows

Group	Vitamin D fed per cow daily	Vitamin D per gram of butterfat			
		At start of experiment	After experimental feeding for		
			1 month	2 months	3 months
	*I.U.**	*I.U.*	*I.U.*	*I.U.*	*I.U.*
Group 1 Alfalfa hay	10,000	.19	.21	.32	.46
Group 2 Prairie hay	5,000	.19	.15	.16	.22
Group 3 Beet pulp		.19	Too weak to measure		

* I.U. = International unit of vitamin D.

units of vitamin D in 20 pounds of prairie hay declined from 0.19 International units per gram of butterfat at the start to 0.15 International units for the first month then increased slowly to 0.22 International units per gram at the end of the three months' period. The butterfat from the beet pulp control group decreased in potency until it was too weak to measure, although there was some evidence of a trace of vitamin D in some of these samples.

The results of studies on methods for concentrating the vitamin D of butterfat to facilitate the assay of relatively impotent samples are summarized in Table 3. Method 1 refers to the procedure outlined by Bechtel and Hoppert (3). In trial 1 nine rats receiving 2.4 grams of summer butterfat fed directly at the rate of 0.3 gram daily for the first eight days of

TABLE 3

The effectiveness of methods of concentrating the vitamin D of butterfat for assay purposes

Material tested	No. of rats	Average healing*
Method 1, Trial 1		
2.4 gm. fat—direct	9	0.75+
Extract from 2.4 gm. fat	9	0.03+
Reference Standard—4 I.U.**	4	1.31+
Method 1, Trial 2		
Extract from 5 gm. fat	6	0.79+
Residue from 5 gm. fat	5	0.38+
Method 2, Trial 1		
3.2 gm. of fat—direct	8	0.91+
Extract from 3.2 gm. of fat	9	0.33+
Residue from 10.6 gm. of fat	3	1.16+

* A narrow continuous line of mineral deposition is designated as a 1+ healing.
** I.U. = International unit of vitamin D.

the test period showed an average healing of 0.75+. Nine litter mates receiving extract equivalent to 2.4 grams of the same fat showed an average healing of only 0.03+. The extract was mixed with a 40-gram portion of rachitogenic diet and fed during the first part of the test period. The sensitivity of the colony at this time is indicated by the 1.31+ healing shown by four rats receiving 4 International units of vitamin D in Standard Reference Oil.

In trial 2 each of six rats was fed an amount of extract equivalent to 5 grams of fat. Litter mates were fed the residue left from the extraction process in an amount equivalent to 5 grams of the original fat to see if unrecovered vitamin D could still be detected in the fatty residue. The extract equivalent to 5 grams of fat showed an average healing of 0.79+ and the fatty residue gave a healing of 0.38+, which furnishes direct evidence that all the vitamin D was not being recovered in the extraction process.

The procedure was modified to include a digestion of the alcohol-fat mixture under a reflux condenser for a period of one hour for each of the successive extractions made on a butterfat sample. The results of this modification are shown under Method 2 in Table 3. Eight rats receiving 3.2 grams of fat directly showed an average healing of 0.91+ while nine litter mates receiving the extract equivalent to 3.2 grams of the same fat showed healing of only 0.33+. The fatty residue left from extracting the 32 grams of fat was divided into three equal parts so that each portion represented the fatty residue left from the extraction of 10.6 grams of fat. The rats receiving these portions showed an average healing of 1.16+, indicating that an appreciable amount of vitamin D still remained in the fatty residue. These results vary widely from the experiences reported by Bechtel and Hoppert (3), but are in close agreement with the extensive studies of the English investigators, Kon and Booth (6) (7). As there seemed to be no method available which could be used with confidence for quantitatively concentrating the vitamin D of butterfat, the samples were assayed as completely as possible by feeding the butterfat directly.

DISCUSSION

The alfalfa hay used in this investigation showed twice the vitamin D potency of the prairie hay, although both lots of hay were of good average quality and had comparable curing histories. Whether alfalfa will in general be found to contain more vitamin D than prairie hay cannot be determined until more samples have been tested. The vitamin D found in these samples amounts to 500 International units per pound of alfalfa hay and 250 units for prairie hay. The significance of these figures is emphasized when they are compared with the vitamin D requirements of animals. For instance, Bechdel, Hilston, Guerrant and Dutcher (1) have shown that about 300 International units of vitamin D daily per 100 pounds of liveweight will

suffice to protect a calf from rickets up to seven months of age. Two pounds of the alfalfa hay used in this experiment would meet the above requirements for a seven-months-old calf. These observations are in harmony with experimental results wherein calves have been protected from a deficiency of vitamin D by small amounts of hay.

It has been shown by experimental work at the South Dakota Station, Wallis (13), that liberal-milking cows have a certain vitamin D requirement which must be met if severe deficiency symptoms are to be avoided. The alfalfa and prairie hay used in this experiment evidently supplied enough vitamin D to meet the body requirements of the cows and to furnish an available surplus which provided for an increasing amount of vitamin D in the butterfat produced. Calculations based on the fat percentage and the amount of milk produced during the third month of the experiment show that 1.77 per cent of the 10,000 International units of vitamin D in the alfalfa hay was recovered in the milk. Similar calculations indicate that 1 per cent of the 5,000 units being fed the cows on prairie hay was recovered in the milk. Just what effect the amount of milk produced and the fat percentage of the milk may have on the amount of vitamin D recovered from a given intake cannot be definitely stated, but variations in these factors would undoubtedly affect the results obtained. The higher percentage recovered in the milk from the alfalfa hay group may be due to the fact that one of these cows was still milking much more liberally than the rest of the animals at the time the samples were taken for the third month. In any event, the amount of vitamin D recovered in the milk represents only a small percentage of what is ingested in the normal rations of dairy cows. The percentage of vitamin D recovered from the smaller amounts in normal rations is of about the same order as the percentage recovered from the feeding of larger amounts in the form of vitamin D concentrates as previously mentioned in the introduction.

The amount of vitamin D in the butterfat from the cows on the molasses beet pulp decreased to such an extent that it was no longer possible to measure it, although occasionally a rat receiving 12 or 15 grams of this fat would show a slight amount of healing. Subsequent work at this station, Wallis (13), has shown that liberal-milking cows may deplete themselves of vitamin D in three or four months. Butterfat from such animals will not initiate healing in rats when fed at 12 to 15 gram levels. The slower decrease in the vitamin D potency of the butterfat from the beet pulp control group in this experiment may be due to the smaller milk production of these animals as they were nearing the end of their lactation. In fact, one cow in this group went dry before the experiment was completed.

The results of this experiment indicate that even with the smaller vitamin D intake of normal rations there is a tendency for the vitamin D in the butterfat to increase with increases in the vitamin D content of the ration.

Thus, at the end of three months the butterfat from the group getting 10,000 units daily in alfalfa hay showed a potency of 0.46 International units per gram, that from the prairie hay group getting 5,000 units daily showed a potency of 0.22 International units per gram, and that from the beet pulp control group was too weak to measure. These results indicate that the vitamin D of hay constitutes at least one of the sources of the vitamin D which appears in the milk. Although the absolute potencies indicated for the less potent samples of butterfat should not be emphasized too strongly because of the difficulties involved in accurately assaying such small amounts of vitamin D, the general relationships just pointed out are fairly clear cut and are undoubtedly significant.

SUMMARY

Representative samples from comparable lots of alfalfa hay and prairie hay were assayed for vitamin D. The alfalfa contained 1.10 International units, and the prairie hay 0.55 International units of vitamin D per gram. When these lots of hay were fed to comparable groups of dairy cows the butterfat produced by the group receiving alfalfa hay was more potent in vitamin D than the butterfat from the group receiving prairie hay, which was in turn more potent than butterfat from a beet pulp control group. Between 1 and 2 per cent of the vitamin D in these normal rations was recovered in the milk. Attempts to quantitatively concentrate the vitamin D of butterfat to assist in the assay of relatively impotent samples were unsuccessful.

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HIGH RECORDS CONTRASTED WITH UNSELECTED RECORDS AND WITH AVERAGE RECORDS AS A BASIS FOR SELECTING COWS*

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While making some preliminary studies of suitable ways to test the relative values of production records, singly and in various combinations, for predicting future records of the same cow and for evaluating her transmitting ability, we noted an article by Copeland (2) purporting to show some advantages for using a cow's highest record as an index to her lifetime producing ability and to her transmitting ability. As our data, which came from a different source, seemed appropriate for testing Copeland's conclusions, we repeated a part of his analysis on our own material and added a few other features which, it is hoped, will demonstrate why the *ex post facto* selection of the highest record is an unsound procedure—a procedure more likely to lead to fallacious results than if an unselected record or, better still, the average of all a cow's records were used as the measure of her ability.

A major difficulty associated with the use of the highest record in comparing cows (and not mentioned by Copeland) is that in practice most comparisons will need to be made between cows which have not completed an equal number of recorded lactations at the time the comparison must be made and which, therefore, have not had the same number of chances to make a high record. The obvious unfairness so introduced seems of so much practical importance that we will refer to it again in some detail after first presenting our findings on a basis comparable with Copeland's.

DATA STUDIED

We studied the records of 115 Holstein cows, each of which had completed at least six Herd Improvement Registry lactations and had one or more daughters each of which had completed at least two records.[1] All records were brought to a mature "B" basis by use of the conversion factors listed in the Holstein Red Books.

FINDINGS

The first step was to compare the correlations between various records and averages. These are shown in Table 1 along with the corresponding ones

Received for publication March 4, 1939.

* Journal Paper No. J–626 of the Iowa Agricultural Experiment Station, Ames, Iowa.

[1] These data were those included in some originally assembled for another purpose—that of proving sires. Here a 6-record cow was used as many times as she had tested daughters. Actually there were 89 different cows. If the dam of a 6-record cow had two or more records, that dam was treated as a daughter. The relation is a parent-offspring one in either case. The findings should be practically the same as if there had actually been 115 different 6-record cows, each with one tested daughter.

reported by Copeland. For the four "repeatability" comparisons (the first four in Table 1), our coefficients are lower than those reported by most students of this question, while those of Copeland are among the highest we have ever seen. More typical are findings like those of Plum (5) that a correlation of .60 existed between records of the same cow in the whole population of records from many herds, but that on an intra-herd basis the correlation between records of the same cow was reduced to .40. Perhaps a high degree of heterogeneity from herd to herd existed in Copeland's data.

TABLE 1

Correlation coefficients for Holstein H.I.R. records, Jersey R. of M. records and Jersey Herd Test records

Variates correlated	Coefficients of correlation		
	115 Holstein H.I.R. cows	197 Jersey R. of M. cows*	166 Jersey Herd Test cows*
First record with the second	.30	.71	.78
Second record with the third	.42	.77	.80
Third record with the fourth	.55	.69	.75
Fourth record with the fifth	.45	.59	.83
First with ave. of next four	.49	.62	.80
First with ave. of all five	.68	.75	.88
Highest with ave. of all five	.90	.92	.92
Highest with ave. of other four	.83	.....	.....
Lowest with ave. of all five	.79	.....	.....
Lowest with ave. of other four	.70	.....	.....

* Copeland's data.

If the various records were all equally correlated (r) with each other, the correlation between the first and the average of the next four would be expected to be $r\sqrt{\frac{4}{1+3r}}$. It is a little lower than this (if for r is used the simple arithmetic average of the four repeatability correlations shown) in all three sets of data (especially so in the Jersey R. of M. records), thus indicating that the correlations between non-consecutive records (not shown) average somewhat lower than those between consecutive records. Similarly, if all the correlations between the individual records were equal to r, the correlation between the first record and the average of the first five records would equal $\sqrt{\frac{1+4r}{5}}$. Again the actual figures are lower (much lower in the case of the Jersey R. of M. records) than they would be if the non-consecutive correlations averaged as high as the consecutive ones which are shown.

The numerical values to be expected in the case of the correlation between *the highest record* and the average of all five are not clear because of the complex statistical relations brought about by the *ex post facto* selection of the

highest record. That such selection has an effect on the correlation subsequently calculated can be made clear by considering an extreme case in which it is assumed that we have samples of five records each from cows between which there really are no intrinsic differences, the variation between the various records being wholly due to varying external circumstances and to sampling variations. This is the same statistical problem as would exist in

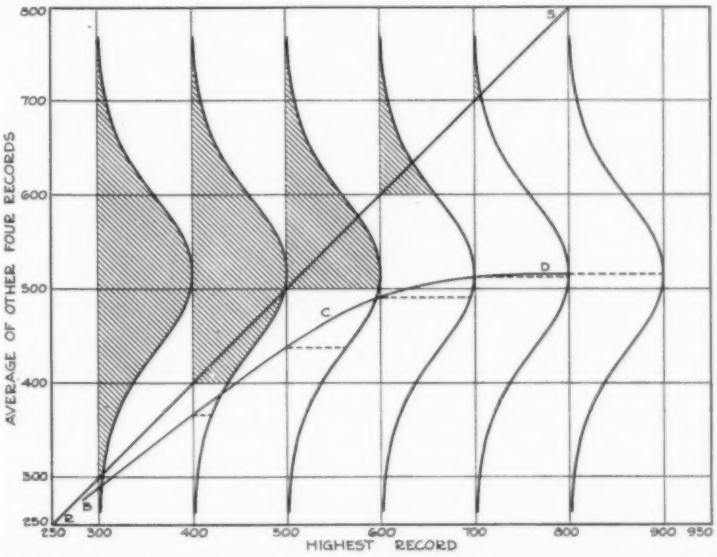

FIG. 1. The statistical consequences of the *ex post facto* selection of the highest record among five. The normal curves, all drawn at the same height on the ordinate axis, illustrate the variation to be expected between different records of the same cow in a population of cows which all have exactly the same real ability. In such a population it would sometimes happen that the highest of five records would be very high; sometimes it would be moderately high; and sometimes even the highest record would be moderately low. When a sample of five records is located along the abscissa according to the highest record in it, the other four must come from the unshaded portions of the frequency curves —*i.e.*, from below the line RS. When the highest record is large, it can be considerably larger than the average of the other four records; but when the highest record is itself rather low, it cannot be very different from the average of the other four. This gives rise to a high correlation between the high and the average of the others, to curvilinear regression, and to a funnel-shaped distribution.

studying random samples of five records each, drawn from the same universe. Since all of the other four records must be lower than the high record, it follows that the samples in which the high record itself has a low value will be samples in which all five records happened to come from the lower part of the frequency curve. But in such cases the other four will rarely be *much* below the high one and the two variates will be closely correlated.

Figure 1 is intended to show graphically what would happen in such a case if the highest of the five records in each sample were correlated with the average of the other four. Six normal curves with their means at the same level have been drawn at intervals of 100 lbs. along the abscissa to show the restrictive effect of locating the sample along the abscissa according to the highest of the five records in it. In each case the other four records must all be below the diagonal RS, and must come from the unshaded portions of the normal curves. At the right hand side of the graph (where the high record happens to be very high) little restriction is laid on the magnitude of the other four records, but toward the left hand side most of the unshaded portion of the curve lies very near the diagonal RS and the average of the other four records cannot be far below the high record.

Because of the constricting influence of the high record on the magnitude of the other four, the total distribution becomes funnel shaped and the line BCD (drawn through the means of the unshaded portions of the six normal curves) showing the regression of the average of the other four on the high one is curvilinear in character. The extreme narrowing of the distribution, when the high record itself is not very large, is particularly potent in giving a large correlation between the high record in the sample and the average of

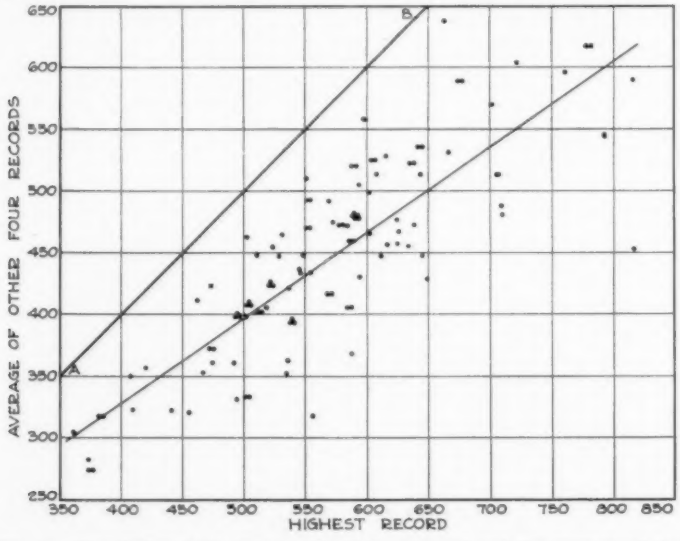

FIG. 2. Correlation (.83) between the highest record and the average of the other four records in a population of 115 H.I.R. cows. All points must fall below the diagonal AB. The regression line is the best-fitting straight line but does not tell the full story, since the real relation between the two variates is curvilinear. The restrictive influence of the highest record on the magnitude of the other four records is especially evident toward the left side of the diagram.

the other four records, even in an extreme case like this where the samples come from the same universe (as from a group of cows all with the same producing ability).

Actually, of course, there are differences between the cows, too, and this gives the regression line more of an upward slope and somewhat less curvilinearity although the funnel shape of the data and the extreme restriction at the left are conspicuous features of the actual data as shown in Figure 2. It is thus apparent that the correlation coefficient for the high record and the average of the other four owes a part of its magnitude merely to the fact that the first mentioned variate was selected *because* it was the high record. Because of the curvilinearity and the funnel shape, the biometric relations seem complex and we do not know how to separate the observed correlation coefficient into the spurious part which comes from this useless *ex post facto* arrangement of the data and the part which would show the genuine usefulness of the high record in predicting records not yet made when the high one was selected.

When the highest record is correlated with an average of the five which include it, the coefficient becomes still larger. The situation is the same as shown in Figure 2 except that each point is now moved upward one-fifth of the distance which in Figure 2 separates it from the line AB. Naturally those lying farthest away are moved most and so the correlation is distinctly increased but no new knowledge is gained.

Figure 3 shows the first record as correlated with the average of the other

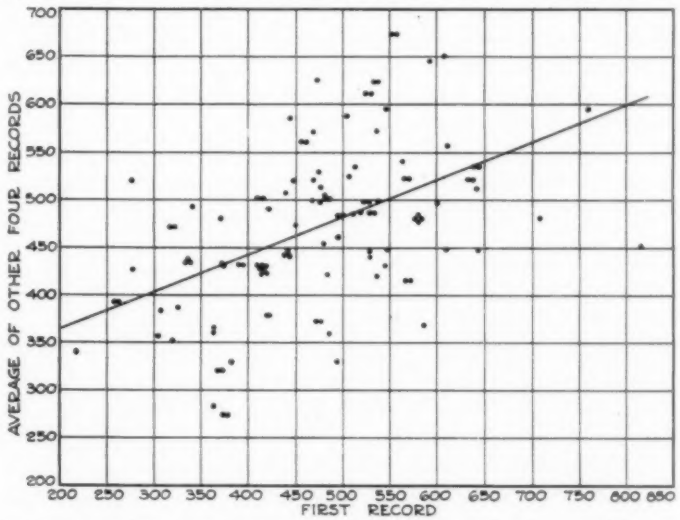

FIG. 3. Correlation (.49) between the first record and the average of the next four records. Same cows as in Figure 2. The straight line shows the linear regression of the average of the other four records on the first record.

four. Using the first record sets no restriction on the magnitude of the average of the other four. The other four can all be below the first, or all above it, or some on one side and some on the other. Such a correlation is an unbiased estimate of the usefulness of the first record for predicting the average of the other four.

WHY NOT THE LOW?

To demonstrate more clearly how subsequent selection of a record *because of* its size affects the correlation coefficient, the lowest of the five records was correlated with the average of the remaining four and also with the average of all five. In our data the low record was less variable ($\sigma = 82$) than the high ($\sigma = 96$) and hence had less influence in determining the variation of the averages of five. For that reason alone, the low might be expected to be somewhat less closely correlated with the average than was the highest record. Moreover, the forces which tend to make the highest record large and those which tend to make the lowest record small may be different enough that the corresponding covariances may not be entirely comparable. For example, some of the low records may have been made under circumstances definitely known to have been abnormal but not specific enough that it would be practical for us (or for the breed association) to undertake any corrections for these circumstances. (Although this is plausible, it seems not to have been important, because the low records averaged only 102 pounds below the average of all five, whereas the high records averaged 98 pounds above. Therefore the distribution seems to have been nearly symmetrical.) While the coefficients for the lowest record (.79 and .70 in Table 1) are not as large as those for the highest record, yet they are much larger than correlations involving unselected records. The reasons are the same in principle as those discussed in connection with Figures 1 and 2.

Before passing from this consideration of the lowest record some comment might be ventured relative to the practical considerations involved. Dairymen frequently raise objections to including all records of production in averages because they feel that some lactations are abnormal. Such objections are usually raised, however, *after* the cow has completed (or nearly completed) a low record. That is, it is difficult (in practice usually impossible) to know whether the circumstances were judged abnormal solely because of them or largely because it was seen that the record was going to be low. Theoretically, the omission of records known to have been made under definitely abnormal conditions for which adequate corrections cannot be made would, we think, enhance the value of the resultant averages. However, practical difficulties connected with deciding what constitutes grounds for omission, and with making sure that the size of the record itself does not influence the decision to use it or omit it, render the advisability of omitting any records from lifetime averages problematical. Certainly the reasons for

such omission would have to be so specific and important that the decision in each case would be automatic. For example, in Denmark only those records made in years when the cow aborted or when she had foot-and-mouth disease are omitted from her average.

THE PREDICTION OF FUTURE RECORDS OF THE SAME COW

The utility of the high record, as compared with that of unselected records, may be tested in the following way freed (we think) of those statistical fallacies which beset the correlation of the high record with the others *from which* it was selected. The highest, lowest and medium records among the first three were compared with the fourth and with the fifth; and then the unselected first, second and third were correlated also with the fourth and fifth records. The results of such a fair test on our data are shown in Table 2. The differences between the correlations in the same column are not statistically significant (on this amount of data—probably the question should

TABLE 2

Correlation coefficients between a cow's first three records (selected and unselected) and her later records

The six variates correlated with the fourth and fifth records	Correlation coefficients with	
	Fourth record	Fifth record
Highest of first three	.61	.29
Lowest of first three	.56	.45
Medium of first three	.57	.31
First record	.39	.39
Second record	.56	.24
Third record	.55	.26

be investigated on more extensive data), but the contrast with the figures in Table 1 shows clearly that much of the apparent superiority of the high record (and of the low) in that table was due to the spurious effects of the method of its choice.

THE PREDICTION OF DAUGHTER'S RECORDS

Table 3 shows the correlations of the average of the first two records of the daughters with the high and low of all five records, with the high, low and medium of the first three, and with the five unselected single records. For comparison, Copeland's coefficients are included in this table. All the coefficients are below .34. The considerable differences between some of them do not seem to fit any particular pattern and are not statistically significant on this amount of data. So far as these data go, any one of these records is about as useful as any other for predicting the production of daughters.

THE USE OF AVERAGES

Averages of all available records are theoretically more useful than single records in evaluating the differences between cows. The authors are at

present studying, on a larger amount of data, the question of whether records actually do behave in this way. Some of the preliminary results are presented in Tables 4 and 5.

TABLE 3

Correlation coefficients between the average of the first two daughter records and various records of the dam

Dam's record which was correlated with the average of the daughter's first two records	Correlation coefficients
Highest of all five records	.29
Lowest of all five records	.15
Highest of first three records	.24
Lowest of first three records	.19
Medium of first three records	.33
First record	.24
Second record	.14
Third record	.23
Fourth record	.29
Fifth record	.13
Copeland's comparisons	
Highest records of 176 dams and highest records of the daughters	.29
Average records of 176 dams and average yield of their tested daughters	.30

TABLE 4

Correlations of averages of a cow's first records with her subsequent records and with her daughter's records

Dam's average	Correlation coefficients					
	Dam's fourth record		Dam's fifth record		Daughter's ave. of first two	
	Actual	Exp.	Actual	Exp.	Actual	Exp.
Ave. of first two records	.59	.47	.38	.47	.24	.25
Ave. of first three records	.65	.51	.38	.51	.27	.27
Ave. of first four records	....	....	.44	.53	.30	.29–
Ave. of all five records	....	....	....	....	.29	.29+

TABLE 5

Correlation coefficients between the average of the last three records of six-record cows and the first three records taken singly and in various combinations

Records correlated with the average of the last three records	Correlation coefficients	
	Actual	Expected
First record	.42	.49
Second record	.45	
Third record	.46	
Average of first and second	.54	.59
Average of first and third	.53	
Average of second and third	.54	
Average of first, second and third	.58	.64

On comparing these tables with Tables 1 to 3, it seems that there is a trend toward increased prediction value of average records as compared with single records.

The "expected" values included in Tables 4 and 5 are the ones which would have occurred if the various records of the same cow had all been equally correlated with each other and if they all had had equal standard deviations and if they had all been equally correlated with the daughter average. The correlation coefficients used in calculating the expected values in Table 4 were the arithmetic means of the ten intercorrelations between the first five records (.39) and of the five coefficients between the cow's five records and her daughter's average (.21). In Table 5, the inclusion of the sixth record gave a mean repeatability of .37.

The divergence of observed from expected values presumably was caused by actual inequalities among those various correlations and standard deviations and by the limited amount of data studied. The expected values, however, serve to indicate the magnitude of the increase which, theoretically, should occur as the correlation coefficients are based on averages of larger and larger numbers. Probably the results will become more regular when more data are included. The present amount of data is not large enough to be expected to show significant differences.

TABLE 6

Distribution of the highest record of five over the five lactation classes

Lactations	First record	Second record	Third record	Fourth record	Fifth record
Number of high records	27	24	20	23	21

THE CASE OF COWS WITH UNEQUAL NUMBERS OF RECORDS

Table 6 shows that the highest record made by a cow is about as likely to occur in any one of the first five lactations as in any other. Assuming a perfectly even distribution of the high record, it follows that the probability that a cow with just one record has already made what would be the highest in five if and when she completed the additional four is .20; in the case of a cow with two records the probability is .40; for the three-record cow it is .60; for the four-record cow, .80; and for the cow with five records, the probability is, of course, 1.0. This shows clearly the unfairness of using the highest record as a basis for comparing cows which have completed unequal numbers of lactations.

The bias introduced by unequal numbers is evident also upon considering the ratio, range/σ. The standard deviation (σ) of records of the same cow, as calculated from our data, is 81.6 pounds. Using Tippett's (6) values for range/σ for varying values of n (the number of records) it is determined that with a cow like the average of ours when $n = 2$ the high record is expected to be 46.0 pounds of butter fat above the mean (473.0 pounds) of the whole sample of 575 records. When $n = 3$ the high record is expected to be 69.0

pounds above the mean; when n = 4, 84.0 pounds above; and when n = 5, 95.0 pounds above. In other words, the expected value for the highest record of two is 473 + 46 = 519 pounds; of three, 542; of four, 557; and of five, 568 pounds. The actual values for the average of the highest of the first three and of all five were calculated for the 115 cows of this study. They proved to be 545 and 571 pounds respectively—values that agree well with those expected theoretically. The bias of comparing the highest records only, when cows have different numbers of records, is obvious.

Copeland thinks it impractical to compare lifetime records of daughters and dams in proving bulls because the daughters and many of the dams will not have completed their lifetime of production at the time when, by using single records or by using only the highest records, it becomes possible to "prove" the bull. In using lifetime records for proving bulls, one merely uses all the information available at the moment when a decision has to be made. In using all of a cow's completed records as her average it is no more necessary to wait until her lifetime is ended than it is necessary, when proving a bull, to wait until records have been made by all of the daughters he will ever sire. The greater the number of animals and the larger the number of records completed by them, the less the error likely to be involved in the "proof." That the figures for the proof next year or the year afterward may be a little different usually means only that the later figures, because of the additional records included, are a bit more dependable. Breeders of dairy cattle are continually faced with the necessity of making decisions concerning cows which have completed different numbers of lactations. The most dependable procedure is to use all the lactation records available at the time the decision needs to be made.

In comparing cows which have completed unequal numbers of records and which have been selected for comparison because their averages are high (as in choosing a son of a high producer), or because their averages are low (as when deciding which of two cows to cull), it is necessary to take account of the decreased variability of averages based on large numbers. Otherwise it would almost always appear that the best producers—and also the worst producers—were cows with only one or two records. The fairest way of doing that seems to be to estimate each cow's real productive ability as equal to the herd average plus (or minus) $\frac{nr}{1+(n-1)r}$ times the excess (or deficit) of her average over the herd average.* In this formula n is the number of lactations included in her average and r is the repeatability of records of the same cow—a figure which is usually around + .3 to + .4 on an intra-herd basis. When it is .4 the above fraction reduces to the simple form $\frac{2n}{3+2n}$. In its use a cow with one record is credited with 2/5 of her apparent superiority, one

* For three independent derivations of this formula, each from a slightly different point of view, see references (1), (3) and (4).

with two records is credited with 4/7 of the apparent superiority of her average, etc. (Similarly in case her average is below the herd average, her real productivity would be estimated at 2/5, 4/7, etc., as far below the herd average as her own actual average is.) This makes it possible to compare, without bias from differences in the number of records they have completed, cows which were selected because their records were high or because they were low. No such precaution is needed in proving sires because their daughters must be unselected (if the proof is to have much validity) and the dams will not often have been selected intensively enough for such a discounting to be important. Usually there will be both low and high producers among the dams (and among the daughters) and the errors from not discounting those with high records will tend to cancel the opposite errors from not discounting those with low records.

SUMMARY

The high correlation between a cow's highest record (or her lowest) and the average of the other records from which this one was selected results largely from the statistical effects of this selection itself. This high correlation does not indicate superiority of the selected record for predicting future records or breeding value. When the highest record is correlated with other records from which it was *not* selected the resulting coefficient (provided all cows have the same number of records) indicates that the high record is of somewhere near the same reliability as an unselected record but almost certainly less reliable than the average of all unselected records. Differences in number of completed records, however, is of so much practical importance in making selected records unfair that the use of the highest record, as an indication of a cow's lifetime producing ability, cannot be recommended.

Averages appear to be more dependable than either selected or unselected single records for evaluating differences between cows.

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GRAPHIC ESTIMATION OF MILK PROTEIN AND MILK ENERGY

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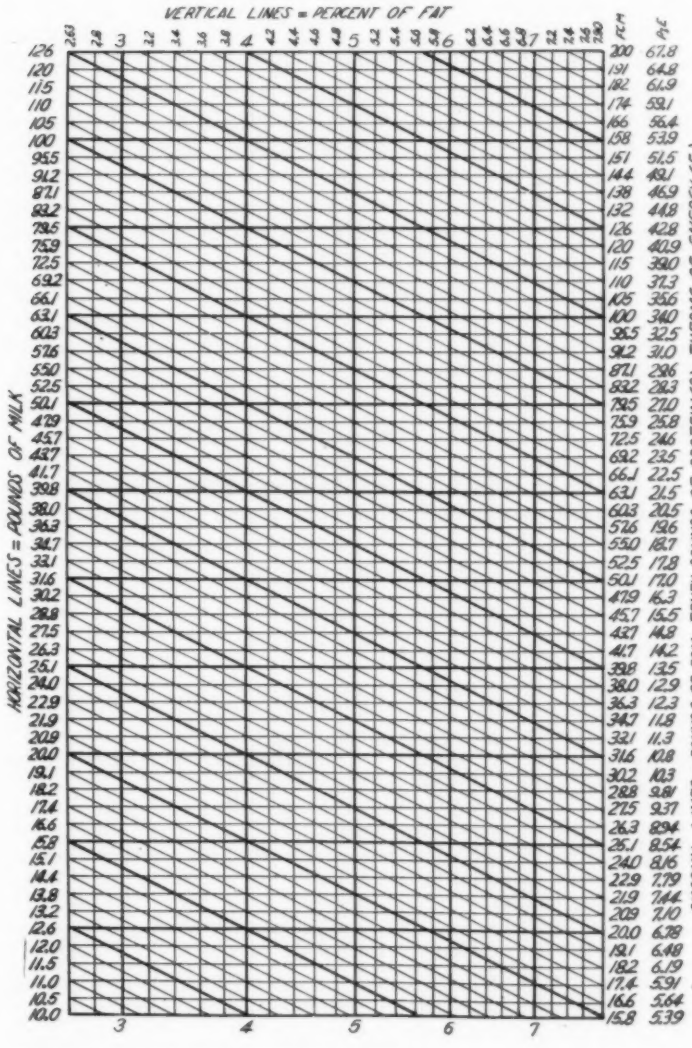

Received for publication, February 24, 1939.

Several designs have been used in the graphic application of the formula, $E = M(.4 + .15f)K$, in which E is milk energy, M is weight of milk, f is per cent of fat in the milk, and K is a constant (1). Milk energy is approximately proportional to milk protein (2). Accordingly, by adjusting the value of K, the right-hand member of the above equation gives the amount of protein or the amount of energy, either in absolute units or in terms of milk of a given fat percentage. The chart on the preceding page is designed to estimate, for a certain weight of milk of a certain fat percentage, the amount of protein and the amount of energy in the milk, first in terms of normal whole 4 per cent milk (FCM), second in absolute units. It is based on the relations, $FCM = M(.4 + .15f)$ and 100 pounds FCM = 3.4 pounds protein = 34 therms milk energy.

An example will illustrate the use of the chart. Find the intersection of the 30.2 pounds milk horizontal with the 7.4 per cent fat vertical. Follow the closest diagonal to the right margin and read, 45.7, 15.5. Thus, according to the chart, 30.2 pounds of 7.4 per cent milk contain 1.55 pounds of protein and 15.5 therms of energy; which is the same amount of protein and the same amount of energy contained in 45.7 pounds of 4 per cent milk (FCM). Follow the same diagonal to the intersection with the 5.4 per cent fat vertical, thence follow the closest horizontal to the left margin and read 38.0, that is 38.0 pounds of 5.4 per cent milk likewise contain 1.55 pounds of protein and 15.5 therms of energy. In other words, a given diagonal cuts the lines for milk and fat per cent at equal protein and energy content. As between breeds there may be a small systematic error in the protein estimate, the formula tending to over-estimate slightly for Guernsey and Jersey cows, and under-estimate slightly for Holstein cows.

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THE FLUORINE CONTENT OF VARIOUS FRACTIONS OF MILK AND COMMERCIAL CASEINS

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Analysis of the various constituents of a low fluorine diet in a recent series of experiments indicated that certain commercial caseins were badly contaminated with fluorine. On the average, fresh milk contains 0.1–0.28 parts of fluorine per million. On the basis of these figures one would expect at most only 10 p.p.m. in the casein if the total milk fluorine were concentrated in the product. Commercial casein purified in our laboratory by repeated reprecipitation results in a casein low in fluorine. A sample of casein used was found to contain more than 100 p.p.m., and this could be reduced to 22 p.p.m. by washing several times with dilute acetic acid. This observation led us to make a systematic survey of the fluorine content of the various fractions of milk and of commercial casein.

In these studies all of the fluorine analyses were made by the method previously described (1).

A commercial whole milk was analyzed for its fluorine content. Casein, heat coagulable protein, ether extract, and residue were separated from the milk and each constituent analyzed for its fluorine content. The whole milk contained 0.204 p.p.m., while its constituent parts contained respectively: casein, 0.053 p.p.m.; heat coagulable protein, 0.012 p.p.m.; ether extract, 0.012 p.p.m.; and the residue, 0.145 p.p.m.

The analyses of the various samples of crude casein are given in Table 1.

TABLE 1

The fluorine content of commercial casein

Shipment received	Fluorine content
	p.p.m.
2/1/38	198
3/15/38	115
4/28/38	17
7/1/38	14
8/25/38	359
8/25/38	319
10/25/38	16
Labco	4
Reprecipitated crude casein	4–5

It is apparent that these caseins were contaminated with fluorine. Certain samples were sufficiently contaminated as to cause concern where such products are to be used for nutritional purposes. A casein which contains

Received for publication March 6, 1939.

300 p.p.m. of fluorine would be sufficient to introduce 50–70 p.p.m. where casein supplied the main part of the protein of the ration. This level would cause a very marked increase in the skeletal fluoride as indicated by the work of Ellis and Maynard (2) and unpublished data from this laboratory.

SUMMARY

Whole milk contains small quantities of fluorine. The fluorine content of milk is not concentrated in the protein fraction but can be found largely in the aqueous phase. Therefore uncontaminated caseins should be relatively low in fluorine. Certain commercial crude caseins were found to contain unexpectedly large amounts of fluorine. The advisability of using such contaminated crude caseins for nutritional purposes is questionable in the light of previous experience.

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FACTORS TO BE CONSIDERED IN SELECTING CHOCOLATE-FLAVORED MILK* †

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INTRODUCTION

Very few people question the healthfulness of plain milk but many question the desirability and healthfulness of chocolate milk especially for children. The extensive use of chocolate milk by children has been criticized for the following reasons:

1. Cocoa and chocolate contain theobromine and caffeine.
2. Chocolate milk has a higher sugar content than plain milk.
3. Food value of cocoa is negligible for the amounts used in chocolate milk.
4. Cocoa and chocolate contain tannin-like substances.
5. Cocoa may decrease the digestibility of the milk.
6. In general there are no bacteriological standards for chocolate milk as there are for plain milk, thus giving very little protection to consumers of chocolate milk.
7. Skim milk or low fat milk is sometimes used instead of a milk base meeting state and municipal requirements for fat and solids content.

In spite of these adverse criticisms to the extensive use of chocolate milk by children, the sales of chocolate milk have been increasing. The addition of chocolate or cocoa to milk increases the consumption of milk, which no doubt offsets some of the criticisms. The Milk Dealer (1), July, 1935, in reporting a nation-wide chocolate milk survey mentions that eighty per cent of the chocolate milk sales volume is "plus" volume and not "replacement" volume. This fact shows that, in general, chocolate milk consumers are not regular milk drinkers, and indicates that the addition of chocolate syrup to milk increases the palatibility of the milk for many consumers, thus increasing the consumption.

From the foregoing it is quite evident that mothers, and those who have charge of school cafeterias, might be confused in making a choice between

Received for publication March 6, 1939.

* As used in this paper the terms "chocolate flavored milk" and "chocolate milk" unless otherwise specified, will include chocolate milk made from a whole milk base and also "chocolate flavored dairy drinks." This latter term is commonly understood to mean in many localities a chocolate flavored drink made from skimmed or partially skimmed milk.

Published as Contribution No. 325 of the Massachusetts Agricultural Experiment Station.

† Read before the Conference of Food Service Directors, at the Fourth Annual Meeting in Rochester, N. Y., Nov. 4, 1938.

plain milk and chocolate milk. If the choice is chocolate milk then the problem of selecting the proper cocoa or chocolate-flavored syrup must be solved. This is a difficult task because, generally speaking, there are no standards for chocolate milk drinks as there are for plain milk. For this reason commercial chocolate milk drinks vary widely in composition.

The question arises as to what factors should be considered in making an intelligent selection of chocolate milk drinks. To answer this and other questions regarding chocolate milk, a study was undertaken in the Dairy Industry Department in cooperation with the Department of Bacteriology and Chemistry at the Massachusetts State College. In the experimental studies to date only commercial chocolate-flavored syrups and cocoa powders have been used as flavoring material for chocolate milk, but the use of chocolate liquor is contemplated.

Before discussing the experimental data, a few words should be said regarding the amount of chocolate milk consumed in the United States. To the author's knowledge there are no available statistics giving the yearly consumption of chocolate milk in the United States. However, a nation-wide survey on sales of chocolate milk for the year 1934, conducted by The Milk Dealer (1) gives some indication as to the relative amounts of chocolate milk consumed in various sections of the United States. This survey does not cover all distributors selling chocolate milk, nor does it include the chocolate milk which is made in the home, schools, etc. The amount of chocolate milk sold in various sections of the country, as reported in the survey, is as follows:

Section	*Number of dealers reported*	*Average annual sale of chocolate milk during 1934 (qts.)*
East	10	16,700
Middle West	21	42,252
South	7	15,500
Far West	14	68,827

Middle and far westerners appear to be more "chocolate milk conscious" than consumers in the remainder of the country.

The survey shows also that the sales outlets for chocolate milk over the entire country ranked in the following order of importance: Retail routes and stores tied for first place; schools, second; restaurants, third; factories, fourth; hotels and filling stations, tied for fifth; and roadside stands, sixth. It should be noted that the consumption of chocolate milk in schools is high.

EXPERIMENTAL

Flavor of Chocolate Milk

Flavor blend and intensity are usually among the chief considerations in selecting a chocolate milk. Since the ideal flavor varies with the individual

taste of the consumer, not much can be done along experimental lines on this subject unless a large number of judges are available. When selecting a flavor, the guiding consideration should be not only its first appeal or flavor impression but also its probable effect on the amount consumed by steady chocolate milk drinkers. A highly flavored chocolate milk may appeal favorably at first but may become distasteful to steady users.

The Sanitary Quality of Chocolate Milk

This important factor is too often neglected when selecting a chocolate milk. The effect of the number and kind of micro-organisms in commercial chocolate syrups and cocoas on the sanitary quality of chocolate milk depends largely on the method used in making chocolate milk. Three general methods are in use: 1, adding a prepared syrup to pasteurized milk with no subsequent heating; 2, adding a prepared syrup to milk and then pasteurizing; and 3, adding the dry ingredients to the milk and heating to dissolve and to pasteurize the product.

There is less danger of increasing the bacteria count of chocolate milk from the chocolate syrup or cocoa powder if methods 2 or 3 are used. If the first method is used, considerable contamination from the chocolate syrup is possible. The first method is used to a large extent in localities where laws prohibit pasteurization of plain milk and chocolate milk in the same equipment. The small distributor usually finds that it is more economical to add prepared syrup to cold pasteurized milk than to buy additional equipment for processing chocolate milk. In order to find out just how much contamination might be expected a number of commercial chocolate syrups and cocoas were examined for bacterial content (by the Department of Bacteriology). The findings are reported in Table 1 which shows that considerable contamination may be expected from some of the chocolate syrups if the syrup is added after the milk has been pasteurized and cooled. For example, if the syrup containing 200,000 bacteria per gram is mixed with milk in the ratio of 1 to 10, then we may expect a bacterial increase of approximately 18,000 per gram of milk, which is significant. The first sixteen samples listed in Table 1 are chocolate-flavored syrups and the last eight are cocoa powders. Thirteen additional cocoa powders have been examined in the dairy laboratory and the plate counts ranged from 3,000 to 55,000 bacteria per gram.

Some of the high bacterial counts obtained in the cocoa powders may be due to the fact that some of the samples were not received in their original containers. However, this does not explain the high bacteria counts obtained in some of the syrups, as these samples were received in sealed containers. Directions for making chocolate syrups usually specify a heat treatment of 185 to 200 degrees F. for 15 to 30 minutes. This treatment should make the product sterile from a practical viewpoint. The author is not familiar with

the heat treatment that is given to some of the prepared syrups on the market. However, no coliform bacteria or organisms producing hemolysis on blood agar were found, which indicates the absence of pathogenic organisms in the syrup and cocoas examined.

TABLE 1

The number and types of micro-organisms found in various commercial chocolate flavored syrups and cocoas and the pH of these products

Sample No.	Plate count	Yeasts and molds	Acid formers	Proteolytic forms*	Spore formers*	Coliform	Blood agar	Anaerobes	pH
16	5,000	20	80	Neg.	10	Neg.	Neg.	Neg.	.....
52	1,800	10	30	Neg.	10	Neg.	Neg.	Neg.	.....
53	35,000	400	700	10,000	10,100	Neg.	Neg.	30	6.5
63	200,000	10	100	10	100	Neg.	Neg.	.....	5.3
54	800	80	20	100	100	Neg.	Neg.	10	5.9
64	200	20	40	100	100	Neg.	Neg.	.....	5.7
50	1,000	.....	.....	.....	.....	.....	.....	.....	.....
55	900	100	10	10	10	Neg.	Neg.	10	6.5
51	1,600	40	20	100	100	Neg.	Neg.	Neg.	5.9
21	3,400	10	Neg.	500	100	Neg.	Neg.	20	5.8
56	20,000	Neg.	3,500	100	1,000	Neg.	Neg.	.....	5.2
57	50	Neg.	Neg.	10	10	Neg.	Neg.	Neg.	5.1
58	40	Neg.	Neg.	10	10	Neg.	Neg.	Neg.	5.8
59	20	Neg.	Neg.	10	10	Neg.	Neg.	Neg.	5.1
60	40	Neg.	Neg.	Neg	10	Neg.	Neg.	Neg.	6.2
62	1,100	10	20	100	100	Neg.	Neg.	.....	5.6
1	2,900	300	200	10,000	10,000	Neg.	Neg.	.....	5.5
2	Millions	50	100	1,000	1,000	Neg.	Neg.	.....	5.4
5	Millions	1,000	2,000	500	500	Neg.	Neg.	.....	6.6
6	2,400	200	400	500	500	Neg.	Neg.	.....	5.2
7	1,800	40	100	500	500	Neg.	Neg.	.....	5.6
8	1,600	800	100	1,000	1,000	Neg.	Neg.	.....	5.6
19	25,000	1,000	4,000	1,000	1,000	Neg.	Neg.	.....	5.5
27	8,000	500	200	1,000	1,000	Neg.	Neg.	.....	7.1

Data obtained from R. L. France, Assistant Research Professor, Department of Bacteriology.

* The figures given are not counts but are the highest dilution in which these forms were found.

Table 1 also gives the pH of the various chocolate syrups and cocoas, which ranged from 6.5 to 5.1 for the syrups and from 7.1 to 5.2 for the powders.

Viscosity of Chocolate Milk

An excessive viscosity in chocolate milk is undesirable because it is generally associated with the following objectionable features in the product: 1, too rich appearance; 2, filmy coating after taste in the mouth; 3, appearance of gassy fermentation; and 4, wheyed-off appearance. Just how high the viscosity must be in order to be classed as excessive will again vary with the individual taste. In general the viscosity should be kept as low as possible without obtaining sedimentation.

TABLE 2

The effect of chocolate flavored syrups on some of the properties of milk

Chocolate flavored syrup[1] No.	Relative[2] viscosity of choc. milk	Cream layer	Sedimentation	pH of[3] chocolate syrup	pH of[4] chocolate milk	pH of[4] whey	Curd[5] tension	Relative[6] ease of mixing syrup and milk
	sec.	*cc.*	*cc.*					
1	40.4	0.0	Trace	5.91	6.50	5.93	0	++
2	26.5	1.0	2.0	5.85	6.49	5.95	20	++
3	26.4	1.5	0.0	6.34	6.59	6.08	0	+
4	26.4	1.5	0.0	6.51	6.62	6.08	0	+
5	26.8	2.5	1.0	5.70	6.48	5.90	19	++
6	29.7	1.0	2.0	5.82	6.45	5.95	15	++
Plain milk	24.0	1.5	0.0	.....	6.53	5.91	40	—
7	27.5	2.5	1.5	5.19	6.34	5.89	25	++
8	26.2	1.5	2.0	5.09	6.47	5.98	23	+
9	27.3	1.5	2.0	5.75	6.47	6.00	18	+
10	26.1	2.0	1.5	5.14	6.43	5.98	23	+
11	25.9	2.0	1.0	6.23	6.57	5.91	26	+
12	45.4	0.0	0.0	5.60	6.50	5.92	8	++
Plain milk	24.4	1.5	0.0	.....	6.48	5.99	42	—

[1] Used in the ratio of 1: 11 with milk–3.4 per cent butter fat.
[2] At 48° F. using pipette viscosimeter.
[3] Glass electrode.
[4] Quinhydrone electrode.
[5] Hill–Curd Meter.
[6] + indicates syrup mixes readily with cold milk.
++ indicates syrup mixes less readily with cold milk.

Table 2 shows that commercial chocolate-flavored syrups vary considerably in their ability to affect the viscosity of the chocolate milk. Some of the syrups almost doubled the viscosity of the milk while others increased it only very slightly. Table 3 shows that the suspending agent is chiefly

TABLE 3

The influence of the various components in chocolate milk on the curd tension and other properties of milk

Treatment	Relative[1] viscosity	pH before[2] adding acid	pH of[2] whey	Curd[3] tension
	sec.			
Whole milk— pasteurized[4]	23.6	6.70	6.20	19
Chocolate milk— "	51.0	6.85	6.25	0
Cocoa + milk— "	24.1	6.75	6.16	7
Sugar + milk— "	24.7	6.65	6.19	11
Sodium Alginate + milk— "	38.1	6.80	6.22	0
Water + milk— "	23.3	6.70	6.22	13
Whole milk—raw	23.4	6.70	6.23	37

[1] At 46° F. using pipette viscosimeter.
[2] Quinhydrone electrode.
[3] Used a pepsin-hydrochloric acid coagulant and the American Curd-O-Meter.
[4] 165° F. for 30 minutes.

responsible for the greater viscosity of chocolate milk as compared with plain milk.

Sedimentation in Chocolate Milk

Sedimentation in chocolate milk is undesirable because it detracts from the appearance of the product and also causes inconvenience in serving. The sediment is chiefly crude fiber which is insoluble in milk. Whether this crude fiber has any ill effects on the digestive system or on the digestibility of the milk is not definitely known. In some earlier experiments (2) with white rats which were fed milk containing 7 and 10 per cent of cocoa, it was noted that the indigestible cocoa fiber tended to block the intestinal tract. However, blocking of the intestinal tract was not observed when rats received chocolate milk containing ordinary amounts (one per cent) of cocoa.

Sedimentation may be prevented by the addition of a suspending agent or by using a chocolate syrup from which the crude fiber has been removed. A number of substances such as starches, gelatin and sodium alginate have been used as suspending agents. It is highly desirable to use a suspending agent which will prevent sedimentation without producing excessive viscosity in the product.

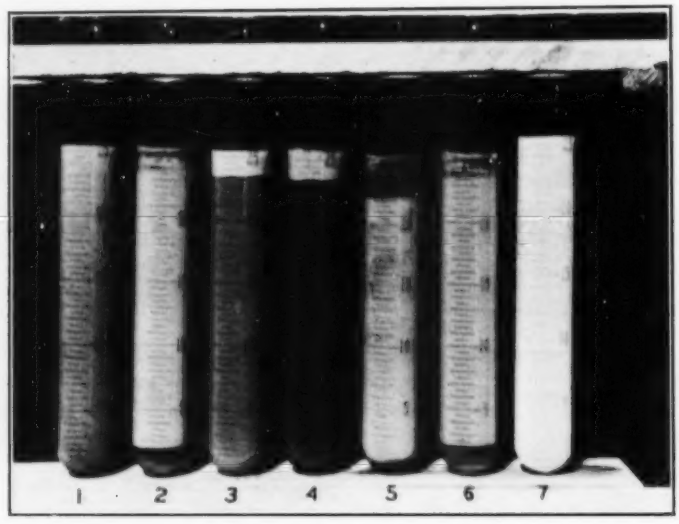

FIG. 1. Appearance of chocolate milk when using various commercial chocolate flavored syrups with a milk base containing 3.4 per cent butter fat.

The test tube at the extreme right contains plain milk, 3.4 per cent butter fat. The numbers on the other test tubes corresponds with the chocolate syrup numbers as given in Table 2.

Note the absence of cream layer and sediment in No. 1; the dark colored cream layer and the amount of sediment in No. 2, 5 and 6; and absence of sediment and the clear, creamy color of the cream layer in No. 3 and 4.

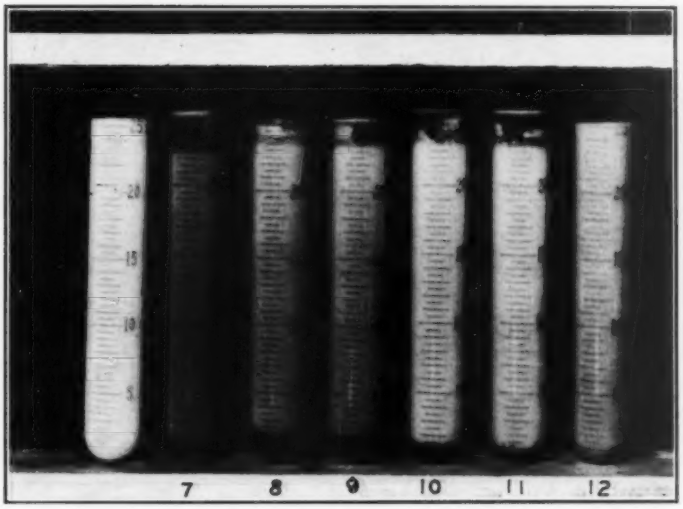

FIG. 2. Appearance of chocolate milk when using various commercial chocolate flavored syrups with a milk base containing 3.4 per cent butter fat.

The test tube at the extreme left contains plain milk, 3.4 per cent butter fat. The numbers on the other test tubes correspond with the chocolate syrup numbers as given in Table 2.

Note the dark colored cream layer and the sedimentation in No. 7, 8, 9, 10 and 11. No. 12 shows no cream layer or sediment.

Table 2 and Figures 1 and 2 show that 25 cc. portions of various chocolate milks in test tubes, after 24 hours, had sedimentations varying from no sediment up to two cubic centimeters.

The Cream Layer in Chocolate Milk

Cream layer or cream line when present may be either desirable or undesirable in chocolate milk, depending upon the kind of chocolate syrup used and also upon the individual preference. If the cocoa fiber has not been removed from the syrup, then a cream line is extremely undesirable because the cream layer will have an uneven dark or dirty-looking color which is sometimes mistaken for curd lumps. If a cocoa-fiber-free syrup is used, then the cream layer will have a more creamy color which has the advantage of indicating to the consumer the approximate amount of butter fat in the chocolate milk. The absence of a cream layer is preferred by many milk distributors.

The creaming of chocolate milk can be prevented by pasteurizing the milk at a high temperature or by homogenization. The addition of a suspending agent to prevent sedimentation also prevents creaming. Table 2

and Figures 1 and 2 show that 25 cc. portions of various chocolate milks in test tubes, after 24 hours, had a cream layer varying from no layer up to 2.5 cc.

The Reaction or pH of Chocolate Milk

Although the pH of the various chocolate-flavored syrups as given in Table 2 varied from 5.0 to 6.5, yet the pH of the chocolate milk remained nearly constant, varying only from 6.3 to 6.6. This is to be expected since milk is highly buffered.

Ease of Mixing Chocolate-Flavored Syrup With Milk

Although none of the chocolate-flavored syrups listed in Table 2 mixed with sufficient difficulty to make them objectionable, yet some differences were noted in this respect. Fine distinctions in mixing ability were not attempted. It is desirable when mixing syrup and milk cold to use a chocolate syrup which mixes easily. The inconvenience in mixing when using a syrup which does not mix readily often results in a product which is not uniform from day to day.

The Curd Tension of Chocolate Milk

The great amount of interest which the public has shown during the past few years in soft curd milk prompted the author to investigate the curd tension of chocolate milk. Though the consensus of opinion seems to be that soft curd milk is more readily digested by infants and people with impaired digestion than hard curd milk, it is questionable whether the curd tension of milk is a matter of practical importance for individuals on a mixed diet.

Table 2 shows that all of the chocolate syrups lowered the curd tension of plain milk, which had an original curd tension of 40 and 42 grams. Some syrups lowered the curd tension reading to 0, others only to 25 grams.

Table 3 shows the effect of the various components in chocolate milk on the curd tension, including the effect of a high pasteurization temperature. The lower curd tension of chocolate milk is not entirely due to the dilution of the milk with syrup, because when the milk was diluted with water the curd tension was found to be 13 grams as compared to zero grams for chocolate milk. The suspending agent sodium alginate was more effective in lowering the curd tension than either sugar or cocoa. The varying effect of the components in chocolate milk on curd tension cannot be explained by differences in pH. The results to date show no correlation between the curd tension and digestibility of chocolate milk as measured by animal experimentation and in vitro.

Effect of the Acidity of Milk on Chocolate Milk

Some distributors use an inferior grade of milk in their chocolate milk on the assumption that the chocolate or cocoa will cover the defective flavor

of the milk. Table 4 and Figure 3 show what happens when milk of varying degrees of acidity is used with a specific chocolate syrup for making

TABLE 4

The effect of the acidity of skim milk, 2% b.f. milk, and 4% b.f. milk on the appearance and viscosity of chocolate milk[1]

Sample No.	Milk used	Acidity of milk	Relative viscosity[2]	Amount of separation[3]		
				After 1 day	After 2 days	After 4 days
		%	*sec.*	*cc.*	*cc.*	*cc.*
1	Skim	.16	31.9	2.5	5.5	9.0
2	"	.18	31.6	4.0	8.0	11.5
3	"	.20	31.3	7.0	9.5	13.0
4	"	.24	30.0	11.0	14.0	15.5
5	2% b.f.	.16	37.2	0.0	0.0	0.5
6	"	.18	35.5	0.0	Trace[4]	2.5
7	"	.20	33.7	0.0	4.5	6.0
8	"	.24	31.9	5.5	8.0	10.5
9	4% b.f.	.16	46.3	0.0	0.0	0.0
10	"	.18	42.3	0.0	0.0	Trace[4]
11	"	.20	38.9	0.0	0.0	Trace[4]
12	"	.24	36.4	0.0	7.0[4]	10.0

[1] Used a commercially prepared chocolate flavored syrup, 1 to 11.
[2] Determinations made with pipette viscosimeter at 52° F. after samples had aged for 24 hours at 38° F.
[3] Lightest colored portion.
[4] Separation not distinct.

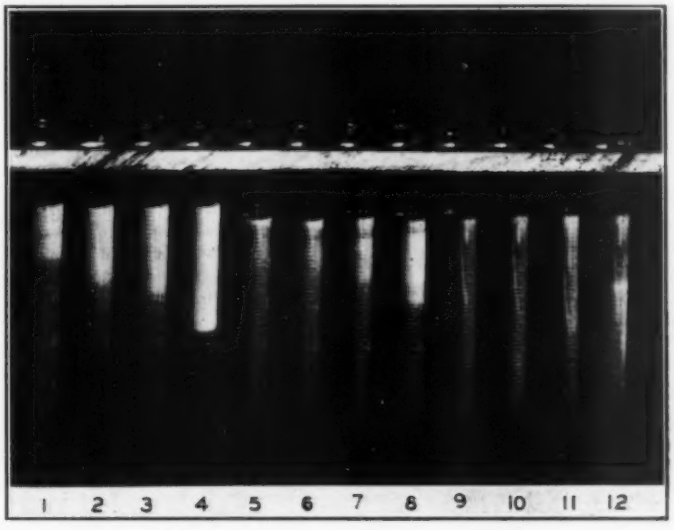

FIG. 3. The effect of the acidity of skim milk, 2 per cent butter fat milk, and 4 per cent butter fat milk on the appearance of chocolate milk.*

Acidity	Skim milk Test tube no.	2% butter fat milk Test tube no.	4% butter fat milk Test tube no.
.16%	1	5	9
.18%	2	6	10
.20%	3	7	11
.24%	4	8	12

* The white portion shows the amount of separation of chocolate syrup from the milk.

chocolate milk. Increasing the acidity of milk from .16 per cent to .24 per cent decreased the viscosity of the chocolate milk. This decrease became more marked as the butterfat content of the milk was raised. An increase in acidity was also found to increase the separation in chocolate milk and to a greater degree as the percentage of fat was decreased in the milk.

Effect of Cocoa on the Nutritive Value of Milk as Determined by Animal Feeding

A comparative study of the total nutritive value of chocolate milk and plain milk has been made when both milks were supplemented with iron, copper, manganese, and sugar, and fed as an exclusive diet to white rats. When the animals received equal quantities of plain milk and sugar but varying amounts of cocoa, the one per cent cocoa diet was equal to the plain milk diet; the two and one-half per cent cocoa diet gave questionable retardation in rate of growth, and the four per cent cocoa diet definitely retarded growth. However, in a later experiment it was found that when cod liver oil and brewers yeast were added to the milk diets, the four per cent cocoa diet was equal to the plain milk diet. These results are given in Table 5.

TABLE 5

Effect of cod liver oil and yeast as supplements to a chocolate milk diet

Diet	Gain after 6 weeks—grams	
	Without cod liver oil and yeast	With cod liver oil and yeast
No cocoa control	60.5	64.5
1 per cent Dutch process cocoa	60.0	.....
2.5 per cent Dutch process cocoa	55.2	.....
4 per cent Dutch process cocoa	47.2	65.3
4 per cent American process cocoa	.....	60.5

In order to secure information on the physiological action of cocoa, urine analyses were made. Samples over a period of 24 hours were collected from 12 animals, four rats on each of the following diets: No cocoa, four per cent Dutch process cocoa, and four per cent American process cocoa. The average results for five trials are given in Table 6. The increase in volume of urine for the chocolate milk diets is probably due to the theobromine and caffeine which are known to have a diuretic action. The cocoa diets also

TABLE 6

Effect of chocolate milk diets on the composition of urine

Kind of cocoa	Volume per day	Specific gravity	Acidity .1 N NaOH	pH	Uric acid mg. per
	cc.		*cc.*		cc.
No cocoa (control)	4.6	1.043	2.3	6.72	0.2064
4 per cent Dutch process cocoa	5.7	1.037	2.6	6.49	0.1913
4 per cent American process cocoa	5.6	1.034	2.4	6.45	0.2023

produced a urine which was somewhat higher in acidity. No significant differences were noted in the uric acid content of the urine.

Fecal pH determinations using the quinhydrone electrode on samples collected from rats receiving no cocoa, four per cent Dutch process, and four per cent American process cocoa, showed no marked differences.

Effect of Cocoa on the Digestibility of Milk in Vitro

The purpose of this study was to check, if possible, the results on the animal feeding experiments. Digestion experiments have been made with milk and chocolate milk containing one and four per cent cocoa. Digestion was carried out with artificial gastric juice, in a rotating machine set in an incubator at 37 degrees C., in order that digestion might go on under conditions somewhat approaching those of the stomach. Samples were removed before digestion and after digesting for two, four, and six hours, and were then analyzed for non-protein nitrogen. Preliminary results are given in Table 7. The data show that milk alone gives the greatest total increase in

TABLE 7*

Effect of cocoa on the digestibility of milk in vitro

Kind of milk	Non-protein nitrogen per 100 cc. of milk			
	Initial	After 2 hrs.	After 4 hrs.	After 6 hrs.
	mg.	*mg.*	*mg.*	*mg.*
Plain milk	23.2	266	311	332
Plain milk + 1 per cent cocoa	22.8	248	302	309
Plain milk	24.6	277	329	351
Plain milk + 4 per cent cocoa	23.8	244	280	294

* Data obtained from Leo Lipman, graduate student in Department of Dairy Industry.

non-protein nitrogen, the four per cent chocolate milk the least, and the one per cent chocolate milk only slightly less than the plain milk. In general these results check with the results obtained by animal feeding experimentation.

Effect of the Addition of Vitamins to Chocolate Milk

Chocolate-flavored syrups and cocoa powders supplemented with various vitamins have been introduced commercially. A commercial chocolate-

flavored syrup containing yeast has been assayed for both vitamins B and G, and was found to contain not less than ten international units of B and not less than eleven Bourquin-Sherman units of G per fluid ounce.

Figure 4 shows the comparative growth of rats fed plain milk (4 per

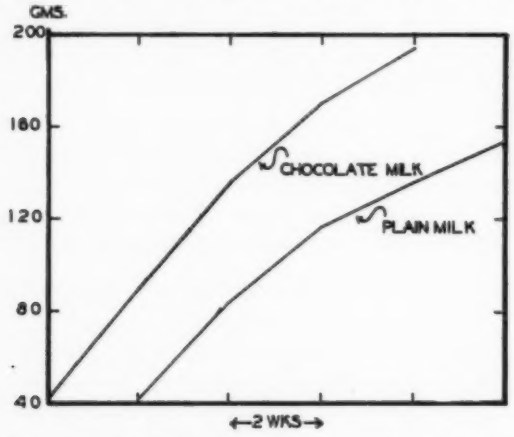

FIG. 4. Comparative growth of rats fed equal amounts of plain milk (pasteurized whole milk—4 per cent butter fat) and chocolate milk (one part chocolate flavored syrup containing yeast plus 11 parts of pasteurized whole milk—4 per cent butter fat). Each curve is the average for 12 animals.

cent butterfat) and chocolate milk (one part chocolate-flavored syrup containing yeast and eleven parts of milk—4 per cent butterfat). The total nutritive value of each kind of milk was measured by exclusive feeding of the milk supplemented with minerals to twelve albino rats. The rats were fed in accordance with the principle of paired feeding. Both groups received the same amount of milk daily, since the milk intakes were equalized within groups. From Figure 4, it is evident that the animals receiving the chocolate milk made considerably greater gains in weight than animals on the plain milk diet. The chocolate-flavored syrup used in this experiment has been reported to contain 3.25 calories per gram. On the basis that four per cent butterfat milk contains 314 calories per pound, 100 grams of plain milk would contain approximately 70 calories as compared to approximately 90 calories per 100 grams of chocolate milk. The growth curves reflect these differences in the caloric value of chocolate milk and plain milk.

SUMMARY

A good chocolate milk should have the following properties:

1. A flavor which appeals to the majority of steady consumers.
2. A low bacteria count. (The maximum bacteria count should comply

with state and municipal laws for the grade of plain milk which is used as a base in the chocolate milk.)

3. No excessive viscosity. (Viscosity should be kept as low as possible without obtaining sedimentation.)

4. Sedimentation is considered undesirable.

5. Cream layer may or may not be present. If cream layer is present, it should be cream colored and not darkly colored or mottled.

6. To avoid excessive sweetness, preferably not over 5 per cent of sugar should be added.

7. The milk used in chocolate milk should not be over .2 per cent in acidity and preferably lower.

8.* A total fat content of at least equivalent to the butterfat required by the State standards for plain whole milk. Total fat then includes the butterfat normally found in the whole milk base and the cocoa fat normally found in the chocolate flavoring material.

9. Cocoa should be used only in such quantities that the digestibility of the milk is not lowered. Approximately 1 per cent by weight of cocoa, in the finished product, does not adversely affect digestibility and is sufficient for flavoring the product.

CONCLUSIONS

(The investigation is being continued and obviously some of the following conclusions must be considered only as preliminary.)

1. Animal feeding experiments indicate that ordinary amounts of cocoa (approximately 1 per cent) do not decrease the nutritive value of milk.

2. Digestion experiments in vitro indicate that ordinary amounts of cocoa (approximately 1 per cent) do decrease the digestibility of the milk slightly, but probably not enough to be of practical significance.

3. Animal feeding experiments, and in vitro digestion trials indicate that four per cent of cocoa in milk definitely decreases the digestibility of the milk.

4. All of the chocolate-flavored syrups and cocoas studied so far have decreased the curd tension of milk. No direct correlation, however, has been found between the curd tension and nutritive value of chocolate milk, as measured by animal feeding experiments and in vitro digestion trials.

5. The pH of chocolate-flavored syrup and cocoa powder had very little effect upon the pH of the chocolate milk.

6. The sanitary quality of some commercial chocolate-flavored syrups examined was poor. If they were to be added to cold milk they would seriously increase the bacterial content of the chocolate milk.

7. Bacteria counts were high in some of the cocoa powders examined, yet

* Refers to the product made from a whole milk base, and does not include "chocolate-flavored dairy drinks."

this is not as serious as for chocolate-flavored syrups, because the cocoa is heated in the preparation of the syrup and less powder is used than syrup.

8. No pathogenic organisms were found in any of the chocolate-flavored syrups or cocoas.

9. Bacteriological standards for chocolate milk equal to those already required for plain milk would be desirable.

10. Standardizing the composition of chocolate milk would be desirable because it would make the product more uniform and would protect the consumer. However, more experimental data are necessary before such standards can be formulated.

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GRASS SILAGE: A CRITICAL REVIEW OF THE LITERATURE*

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The problems of preserving roughages for the winter feeding of livestock are perennial. The preservation of legumes and grasses as hay of high quality is governed mainly by two factors, namely, ideal curing weather, and stage of maturity of the crops. The inability of the livestock man to control these factors results in heavy nutrient losses in the hays during the curing process due to leaching and the loss (shattering) of leaves.

The development of an alternate process of preservation has been the objective of investigators for years. Artificial dehydration of the hay crops shows some promise but, as yet, the process involves a large capital outlay and high operating costs. This at present eliminates it from consideration by the average livestock man.

Preserving these crops as silage seems to be the most logical approach to the solution of this problem. If they can be preserved as silage and stored irrespective of weather, the common haymaking losses will be reduced to a marked extent. However, early attempts to ensile crops of high protein content such as legumes usually met with failure. In many instances an unpalatable silage resulted with a putrid odor and an excessive loss of nutrients. These undesirable factors were attributed by Aldershaw (2) and Whittet (109) to a low content of fermentable carbohydrates in the ensiled material coupled with the stage of growth and the moisture content of the plant material. In trying to improve the quality of the ensiled material, six methods of preservation have been investigated. The principles involved were:

1. The addition of various acids to the green material as it was being ensiled which thereby increased the acidity of the mass to a point where undesirable bacterial action was checked (22).

2. The addition of fermentable carbohydrates to the fodder which favored the desirable lactic acid fermentation and resulted in a natural increase in acidity (82, 110).

3. The inoculation of the fodder with a culture of lactic acid-forming bacteria to increase the number of desirable bacteria which caused a more rapid fermentation and thereby checked the activity of the undesirable organisms (47).

4. The partial wilting of the grasses before ensiling to reduce the bacterial activity (113).

Received for publication May 27, 1939.

* Journal Series paper of the New Jersey Agricultural Experiment Station, department of dairy husbandry.

5. The replacement of the entrapped air with carbon dioxide immediately after ensiling to eliminate plant cell respiration and aerobic bacterial activity (42, 87).

6. The killing of the bacterial flora by sterilization (107).

The first recorded attempt to preserve fodder by the addition of acid was made in 1885 by Giglioli (22), when beet leaves were ensiled by the addition of hydrochloric acid. His product showed approximately 2.2 per cent acidity calculated as lactic acid and in which there was a loss of 11.8 per cent of the digestible nutrients. Little or no additional work was done on the acid method until 1925 when Virtanen began his classic work. His work led to the A.I.V. method (7, 74, 77, 89, 98, 99, 101, 102, 103) which was first put to a practical test in 1928 (102) on two farms in Finland.

The A.I.V. method consists of the addition of a mixture of equal quantities of sulfuric and hydrochloric acids in a 2 normal solution to the fodder as it is ensiled. Sufficient acid is added to bring the acidity of the mass between pH 3.6 and pH 4.0. Virtanen (104) postulated the use of sulphuryl chloride (SO_2Cl_2) which undergoes hydrolysis and yields sulfuric and hydrochloric acids.

This process was followed by the use of a mixture of hydrochloric and phosphoric acids and "Penthesta" solution. The "Penthesta" solution is a solution of phosphorus pentachloride in water which by hydrolysis yields hydrochloric and phosphoric acids (24, 84, 85, 86).

At present, work is being carried on in which phosphoric acid is the sole preservative. Phosphoric acid, or mixtures containing phosphoric acid, not only have a preservative effect on the silage, but also act as sources of phosphorus for animal nutrition and enrichment of the manure (78).

In 1917, Reed and Fitch (82) observed, "When a legume like cowpeas is siloed alone a poor quality of silage is made, but when cowpeas are siloed with some other crop, such as corn, a first-class silage is produced." This observation led to the idea that a silage of good quality might be made from legumes by the addition of a source of readily fermentable carbohdyrate. Reed and Fitch (82) in ensiling trials with alfalfa found "that the addition of materials such as molasses, corn chop and other supplements containing a high percentage of carbohydrate material was effective in preserving the alfalfa as silage." Swanson and Tague (90), working at the same time, found molasses to be the best of the carbohydrate preservatives. Hunter (60) found that the addition of carbohydrates to alfalfa produced a silage with a higher acid content and with a reduced breakdown of the protein as compared with the same type of silage which contained no added preservative.

Following these observations the next attempt in the use of sugar as a preservative was the Defu (29) method. This method not only utilizes sugar but also hydrochloric acid and sometimes phosphoric acid. The acids are

used to increase the acidity to pH 4 and the sugar supplies a substrate so that the lactic acid bacteria, through the formation of lactic acid, are able to increase the acidity to approximately pH 3.5 (29, 43, 45, 50, 70, 80, 81, 107).

The use of dairy by-products, such as whey, has been suggested (5, 6, 27, 28). The lactose present in the whey serves as an excellent substrate for the lactic acid bacteria but due to the large quantity required or to the necessary partial drying so as not to add too much water to the fodder, whey is impractical for common use.

The use of molasses as a source of fermentable carbohydrate seems at present to be the most desirable method which involves the addition of carbohydrates (6, 13, 15, 18, 32, 41, 43, 55, 60, 110). The molasses most generally used is a by-product of sugar refineries. It contains approximately 65 per cent soluble carbohydrates of which from 55 to 60 per cent is fermentable sucrose. Because of its high sugar content, it may be used at full strength or diluted to suit the user. Molasses, like other sources of carbohydrates, serves not only as a preservative, but also as a cheap source of additional nutrients.

Inoculating silage with organisms which produce lactic acid has been suggested (47). The method proposes the addition of a pure culture of a lactic-acid-former which causes a more rapid acid fermentation and thus checks the action of undesirable organisms. Watson (107) stated, "The addition of cultures of lactic organisms has never been accompanied by tangible improvements since the crop usually has a sufficiently large natural lactic-acid-organism flora of its own."

Woodward and Shepherd (113) stated, "It is apparent that the exclusion of air is the only condition required to prevent molding or rotting of silage." They further stated that, "The extent and character of the fermentation, however, is profoundly affected by the moisture content of the material. The higher the moisture content, the more extensive the fermentation and the greater the likelihood that objectionable odors will develop." They advocate a partial wilting of the grass prior to ensiling to a dry matter content of at least 30 per cent. Their results showed that "Partial drying of legumes before chopping for the silo increased the surface spoilage, increased the temperature of fermentation as much as 9° F., and improved the palatability of the silage."

Mikhin, Fokin and Tupikova (73) reported that in grass silage with a normal moisture content carbon dioxide had no inhibiting effect on bacterial activity but if the moisture content was low the gas had a strong inhibitory effect. They also found that green silage with a moisture content of 50 to 55 per cent developed only one-half to one-third the acidity of normal silage.

Bender *et al.* (18) in an ensiling study with a high-moisture grass (60 to 75 per cent moisture) and a low-moisture grass (23 to 55 per cent mois-

ture) found that the low-moisture material developed a temperature of 160° F. and showed considerable charring while the high-moisture material showed a maximum temperature of 109° F. and no charring. They further found (14) that the high temperatures developed with low-moisture material could be reduced if sufficient pressure was developed on the mass to exclude the air. However, the wilting of the green material prior to ensiling reduced the carotene content to a marked degree (91).

Erf (42) is of the opinion that if fodder is packed in air-tight containers at a low temperature and with an atmosphere of non-oxidizing gases a palatable, well-preserved product results. He found that packing the material in air-tight receivers or silos with dry ice was a desirable method of preserving legumes. He reports that this silage is very palatable and that it is a good preservative of the "fertility factor." The fertility factor referred to is the alkaloid, betain. The replacement of the entrapped air with carbon dioxide in the ensiled mass was attempted on both a large and a small scale by Schmidt (87). The method was one in which the air in the filled silo was evacuated and the space refilled with carbon dioxide. Although the fodder seemed to keep well under laboratory conditions, there was a distinct formation of butyric acid in the large silo which was thought to be caused by an incomplete evacuation of the mass. The value of creating an anaerobic condition lies in the fact that plant cell respiration and other aerobic activities such as those of the yeast and molds will be eliminated. Such a condition, however, will be favorable for the growth of desirable or undesirable types of anaerobic organisms. Unless conditions are favorable for a rapid formation of lactic acid only a poor quality silage can possibly result due to the action of putrefactive types of bacteria.

The use of antiseptics was first suggested in 1886 (107) when carbon bisulfide was used to check respiration. Since then attempts have been made to sterilize the fodder by heat produced by steaming the silage in the silo and also through the use of electrical current. Chemical sterilizing agents such as formaldehyde, formic acid, and Torosilon, which liberates a sterilizing gas, have been used but the results did not warrant their further use. "Complete sterilization of the mass can be dismissed from the mind as a practical alternative in making silage," according to Watson (107).

The process of ensiling in its essentials involves a storing of the fodder with the expulsion of air through pressures developed by the mass of material. This is followed by a series of reactions involving normal plant cell respiration which utilizes oxygen and in turn is succeeded by reactions caused by anaerobic bacteria. The type of bacterial action depends to a large extent on the type of material ensiled. The desirable type of action is that which results in the rapid formation of lactic and acetic acids from the fermentation of carbohydrates. When an acidity of pH 3.5 to 4.0 is reached the action of putrefactive bacteria and bacteria giving rise to butyric acid is checked (104).

The course of reactions in the ensiling process may be classified under two general headings; aerobic and anaerobic. When fodder is placed in the silo there is a certain amount of air entrapped. Until the oxygen of this air is consumed, the plant cell respiration continues (104) and yields mainly carbon dioxide and water; aerobic organisms such as the yeasts and molds continue to multiply. When the conditions become anaerobic, the aerobic organisms, particularly the yeasts and molds, although considered dead and unable to reproduce, still function as enzyme systems and continue to carry on transformations, such as the formation of alcohol and other metabolic end-products (106). It is, therefore, essential to exclude as much air as possible when filling the silo so as to limit the number of yeasts and molds present by limiting the time during which they are able to multiply (59). Some of the metabolic products of aerobic activity such as ethyl alcohol may be oxidized to acetic acid under the ensuing anaerobic conditions.

When the available oxygen of the air has been completely utilized, the anaerobic organisms commence their fermentative reactions. The most important of the anaerobic organisms are the acid-forming (59) and the proteolytic bacteria (4, 102). The proteolytic organisms are able to transform proteins to such products as ammonia, amino acids, amines, and amides. As these are metabolic waste products, they will be formed in greatest quantity when the nitrogen requirements of the organisms are lowest. They are most apt to occur when the organism is using protein as an energy source as well as for the synthesis of cell substance. Two conditions will prevent to a great degree excessive protein decomposition. First, the addition of utilizable carbohydrates suppresses the utilization of protein for energy. In this case protein will be utilized only for the building of cell material for the bacteria. In this form the protein is still available as nutrient material for the animal. Second, controlling conditions by adjusting the acidity of the silage through the addition of acids will inactivate proteolytic bacteria and their enzymes. However, the addition of fermentable carbohydrates checks the decomposition of protein in both ways in that it supplies a source of energy for the bacteria and adjusts the acidity of the silage by the bacterial formation of lactic and acetic acids. Silage with an adequate carbohydrate supply shows a predominance of lactic-acid-formers (5).

The optimum pH for silage preservation is between 3.5 and 4.0 (104, 105). When the pH of the mass is 3.5 the rate of the plant cell respiration is reduced to 10 per cent of the rate at a pH approximating neutrality (104). The harmful bacterial action which gives rise to the formation of butyric acid or the breakdown of protein to undesirable products is completely inhibited at a pH of or below 4 (104). As it has been shown that the spores of butyric-acid-formers can tolerate an acidity of pH 3.5 (96) it is necessary to maintain an acidity at a pH of or below 4 so that these spores do not regerminate into active organisms.

In all processes of ensiling green fodder there are losses of dry matter. These losses may be partially accounted for by such volatile materials as carbon dioxide, hydrogen, methane, and ammonia which are the result of bacterial action and of plant cell respiration. Drainage from the silo carries with it a portion of the soluble material. The addition of preservatives is not only an attempt to make a more palatable feed but also to reduce these common losses to a minimum with special emphasis on the loss of volatile materials. It will be seen, therefore, that in order to minimize these losses the fodder must be stored compactly so as to exclude as much air as possible. Cell respiration is thereby reduced. The mass of silage must also be acidified to stop undesirable bacterial activity. The use of preservatives at present has the sole objective of increasing the acidity of the mass.

Watson (107) stated, "The loss in the ordinary process of silage varies from 25 to 35 per cent of starch equivalent, according to the container used and general quality of the final product. The loss of digestible crude protein may be as high as 40 per cent, particularly in stacks or clamps, but may be as low as 10 per cent in some of the best silages made in a suitable container."

Camburn, Ellenberger, Newlander, and Jones (31) in a comparison of four different methods of preserving grasses found that, "The nutrient losses from alfalfa and timothy due to sun curing (A), artificial drying (B), ensiling without molasses (C), and ensiling with molasses (D), only those occurring in the body of the silo being considered, and excluding top spoilage, on the percentage basis were:

	A	*B*	*C*	*D*
Dry matter	15.8	5.0	9.3	8.2
Ash	21.5	9.9	1.1	6.8
Crude protein	22.8	16.7	5.8	8.0
Crude fiber	11.8	+1.0	1.9	0.6
Nitrogen-free extract	13.8	3.0	17.9	13.9
Ether extract	28.4	4.5	+21.8	+15.6"

They stated that, "These data indicate that the molasses nutrients were not wasted during the ensiling process and that only enough were fermented to produce a desirable amount of acidity." A comparison of ordinary silage (no preservative added), A.I.V. silage, and molasses silage with regard to the nutrient losses by Davies, Botham and Thompson (35) showed the following results:

	**Ordinary*	*A.I.V.*	*Molasses*
Dry matter (crude)	24.1	18.1	12.5
Ether extract (crude)	+53.2	+28.6	+35.3
Fiber (crude)	24.0	23.0	5.8
Protein (crude)	28.2	11.4	8.2

* Figures are percentage losses on the dry basis unless otherwise stated.

A 110 per cent gain in digestible ether extract was noted in the ordinary silage, and a 63.6 per cent gain in A.I.V. silage acidified to pH 3.5. Ordinary silage had a 22.6 per cent reduction in digestible fiber, A.I.V. silage 17.1 per cent, and molasses silage 0.6 per cent. While the A.I.V. silage showed the lowest loss of crude and digestible protein in comparison with molasses silage (11.4 per cent and 7.8 per cent, respectively), the molasses silage showed the smallest loss of dry matter (12.5 per cent).

Davies, Botham, and Thompson (35) found that the order of digestibility based on dry-matter content places the ordinary silage lowest (60.3 per cent), the A.I.V. highest (71.8 per cent), and the molasses intermediate (64.3 per cent). According to Watson and Ferguson (108) ensiling increases to some extent the digestibility of the crude fiber and crude protein when mineral acids, molasses, or whey are used as preservatives.

Bechdel (10) in 1923 found that "roughage composed of clover silage and hay was decidedly better for milk production than hay alone as the sole roughage." There is, however, no significant increase in the butter fat content of the milk (21, 58).

The feeding of silage has been shown not to increase the acidity of milk over that of cows on a silage-free diet (71).

Butter produced from the cream of cows which were fed silage was harder and had a better consistency than that from either pasture-fed cows or from cows which received dry feed (19, 56). According to some workers (12, 72, 84) milk produced by silage-fed cows could not be used in the making of hard or fatty cheeses. If the silage which was fed had undergone a butyric acid fermentation the milk produced was not suitable for the making of soft cheeses, and resulted in a "split" or over-fermented product. The use of inorganic acids as fodder preservatives seemed more likely to produce a butyric fermentation in cheese than did the use of organic preservatives (97).

Garrett, Hartman, and Arnold (46) reported that molasses grass silage is superior to either corn silage or beet pulp in the quality of milk produced with regard to initial flavor, stability of flavor in storage, and stability toward the catalytic effects of added copper on the formation of an "oxidized" flavor. This stabilizing effect is thought to be due, at least in part, to the higher carotene content of the grass silage. The color intensity of the milk was found to be greatest when grass silage was fed, intermediate when corn silage was used as the roughage, and lowest when the cows were receiving beet pulp. A correlation was found between color and stability of the milk in resisting the development of off-flavors. Hartman (52) found that milk produced by cows fed second-cutting alfalfa silage preserved with 100 pounds of molasses per ton had a color value only 4 per cent lower than milk produced on fresh early pasture.

Of the vitamins, three have been found to be present in various silages. These were A, B_2, and C (100). As it is supposed that cattle are able to

synthesize B_2 and C, the important vitamin supplied by the silage is A. Taylor (91) has shown that the carotene of silage acted as vitamin A in feeding trials with white rats. The determination of carotene in silages, therefore, appears to be a reliable index of its vitamin A potency. The carotene content of grass silage was found to be twice that of artificially-dried alfalfa hay which had been stored for the same period of time (91). It has been reported that the carotene content of silage is higher than for the corresponding green material (69, 79). However, it is still doubtful as to whether this is an actual increase in carotene or an increase in some other substance which is determined along with the carotene in the procedure used. There is the possibility that the carotene is more readily extracted from the preserved material than from the fresh grasses. Wiseman, Kane, Shinn, and Cary (111) have found that other pigments in the carotene extract of corn silages and hays, which are determined as carotene in the usual method of analysis, amounted to from 11 to 32 per cent of the total extracted pigments.

The vitamin A potency of the milk of cows fed A.I.V. silage equaled in some cases that of the milk of cows on pasture. In all cases the silage produced a milk of higher vitamin A content than did field cured hay (54, 79, 100). Both A.I.V. and molasses silage were found to be superior to silage with no preservative as a source of vitamin A (53).

Brouwer (26) found that the feeding of silage preserved with the use of mineral acids caused an increase in the acidity and ammonia content of the urine. Silages of high acid content (pH 2.2) preserved with mineral acids, fed in moderate amounts, increased the acidity and ammonia content to a greater extent and caused acidosis and an increase in the chloride content of the blood. These results are avoided by feeding sodium bicarbonate in sufficient quantity to neutralize the mineral acids in the fodder. Calcium carbonate frequently is not as effective in producing the desired results.

Crosemann (33) reported that when silages preserved with the addition of hydrochloric and sulfuric acids were fed to animals there was an increase in the ammonia and calcium content and a decrease in the bicarbonate content of the urine and the urine became acid. When large amounts of chloride ions were ingested, as in silage preserved with hydrochloric acid, there was a diminution of the alkali reserves of the blood plasma and an increase in the acidity. These conditions were not produced when silages with sulfuric acid as the preservative were fed.

When grass silage preserved without mineral acids was fed, the pH and carbon dioxide content of the urine were lowered slightly below that of animals fed hay but the pH of the urine of the silage-fed animals remained alkaline. From this it may be concluded that the organic acids which result from carbohydrate fermentation in silage are, for the most part, oxidized in the animal body and do not give an undesirable effect in the urine and blood plasma (30).

Bohstedt, Rupel, King, Peterson and Hegsted (20) found that, "As to any noteworthy physiological effect of A.I.V.-alfalfa silage on the cows, the results of the first experiment are of interest. The alkaline reserve of the blood was lowered on an average 10 cc. per cent during the A.I.V. feeding period. The pH of the urine dropped from 7.5 to 5.9, and the ratio of ammonia nitrogen to the total nitrogen was increased from 0.6 per cent to 11.0 per cent, indicating that the cows used ammonia to aid in neutralizing the acids present. These changes are more or less insignificant, and normal relationships were established within two weeks after the feeding of the A.I.V.-alfalfa silage was discontinued."

When silage is fed in moderate amounts there is no influence on the utilization of calcium, phosphorus, and nitrogen nor is the calcium : phosphorus ratio affected. If, however, silage contains 2 or more per cent of hydrochloric acid there may be an adverse affect. The increased urinary calcium may affect the calcium : phosphorus ratio. However, this may be corrected by the feeding of calcium phosphate, calcium carbonate, or hay or fresh fodder rich in minerals. The addition of calcium phosphate, although improving the calcium and phosphorus balance, decreased the digestibility and utilization of protein (48, 49, 62, 64, 65, 66, 88).

Dairy cattle and calves fed clover silage in which there had been a conversion of 34.4 per cent of the protein to water-soluble compounds such as amides showed a utilization of the amide nitrogen (67). Hart, Bohstedt, Deobald, and Wegner (51) have shown an increase in weight in calves when urea or ammonium carbonate is added to a diet which contains only sufficient protein to maintain the weight of the animal. They conclude, "These results will bear directly upon certain problems now before our farmers. First, in the making of molasses legume silage some of the protein nitrogen is converted to ammonia. It is apparent that this degradation may not mean a complete or even a partial loss of nitrogen. Second, it is also apparent that fertilization of pastures with nitrogen salts, whereby the nitrogen in the plant is appreciably increased, would mean that this increased nitrogen could in all probability be utilized by this type of animal just as well as if it were finished protein. Third, it is entirely possible that the improvement of a low protein ration of poor biological value can be made through the use of molasses and urea; that the proteins formed in these bacterial cells may supplement the rest of the ration better than some protein concentrates that are now in use. This is a problem for the future."

Crops which have grown coarse and rank and as a result would make an inferior hay may be made into silage which can be fed with much less waste (63). Brouwer (25) is of the opinion that it is preferable to make hay of grasses when the weather is satisfactory but if poor haying weather prevails, the making of silage is preferred. When grass is to be used as silage it is preferable to cut the grass at an earlier stage of growth than for hay.

The highest yield of protein per acre is obtained, for most crops, at the first-heads-out stage (36). As the plant grows past this stage, the crude protein decreases and the crude fiber and nitrogen-free extract contents increase.

Alfalfa-molasses silage seems to be superior to alfalfa hay for milk production when the intake is calculated on the dry-weight basis (57). A feeding trial by Horwood and Wells (58) has shown that cows which were fed silage consumed more digestible protein and less total digestible nutrients than did cows fed hay, yet they produced more milk although there was a greater weight gain with the hay-fed group. In experiments with calves, it was found that 25 pounds of grass silage had practically the same feeding value as 10 pounds of good hay from the same meadow (37).

The list of crops* adaptable to the making of grass silage includes cultivated and non-cultivated ones and both annuals and perennials. In general it may be said that all crops which can be made into hay can be stored as grass silage. This would include legumes, grasses, and cereals. The cereal crops such as oats, wheat, barley and rye when harvested in the green or dough stage of growth are very satisfactory. A palatable silage of excellent quality may be made of any combination of green crops that may be desired. The primary desire is to obtain the highest possible yield of nutrients, especially protein, coupled with a low cost of production.

The legumes, especially alfalfa with its high protein content, high yields, and desirable fertilizing effect on the soil, are usually the more preferable. The cereals, which are annuals are less desirable except where they are used as nurse crops for new seedings of alfalfa, clovers and timothy. The most preferred annuals are soybeans or mixtures of soybeans and Sudan grass, peas and oats, and wheat and vetch which give large yields of high quality fodder.

In conclusion it should be noted that many of the questions in connection with the preservation of crops as silage remain unanswered. The field of experimentation in this connection is a fertile one from the standpoint of both pure and applied research as can be seen from this review.

There can be no doubt as to the practical value of ensiling hay crops, either, 1—to provide hay insurance, 2—to use as summer feed when pastures are short, or 3—to replace corn silage in the diet of cattle where soil erosion is a serious factor in farm operations. The one fact which should be kept in mind continually is that ensiling methods developed or to be developed must be simple in operation and positive in action under farm conditions.

The authors wish to express their deepest appreciation to Dr. O. F. Garrett, of the New Jersey Agricultural Experiment Station, for reading and criticizing this paper.

* See reference numbers 1, 3, 8, 9, 11, 16, 17, 23, 34, 38, 39, 40, 44, 61, 68, 75, 76, 83, 92, 93, 94, 95, 111, 114.

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THE THIRTY-FOURTH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ
Secretary-Treasurer

The American Dairy Science Association was called to order by the President, Earl Weaver, in the Administration Auditorium at the University of Idaho, on Tuesday, June 27, at 1:30 P. M. for the thirty-fourth annual meeting.

The program printed in the June issue of the JOURNAL OF DAIRY SCIENCE was prepared by the Program Committee. The June issue also contains the abstracts of the papers presented.

Dean E. J. Iddings, College of Agriculture, University of Idaho, and President E. O. Holland, State College of Washington, were each separately introduced. They officially welcomed the Association membership to their respective campuses.

President Earl Weaver gave the following response:

PRESIDENT'S ADDRESS

"The cordial official welcome we have just heard, together with the fine hospitality we have already encountered since our arrival at Pullman and Moscow convince all of us that this thirty-fourth annual meeting of the American Dairy Science Association will constitute a memorable occasion for each of us individually and for the Association. I am sure I have the enthusiastic endorsement of all the members here when I express to you of Idaho and Washington our appreciation for the efforts you have expended to make our visit a pleasant and profitable one. It should be remembered also that some of our members have found it impossible to be here on this occasion. Many of them communicated to me their regrets that forbidding circumstances arose. I take this occasion to express their best wishes to you of the local committee and to the other members who are here.

The American Dairy Science Association this year has concluded a third of a century of those services for which it was founded. At various times in the Association history new projects and objectives have been inaugurated. Some of these projects have been of a transitory nature and have been entirely accomplished within a longer or shorter period. Others of them have been of a permanent and continuous nature. They demand constant attention. As president of the Association I wish to report that the activities of your officers during the current year have been largely directed to the advancement of these permanent, major objectives of the Association. I do not report any new projects inaugurated during the year.

The Journal: A report on the JOURNAL OF DAIRY SCIENCE will be presented next Friday by Mr. Sutton, the editor. I am convinced the membership will find great satisfaction in this report. However, there are three

matters pertaining to the Journal to which I wish to call your attention. The editor, the secretary of the Association and the Journal Management Committee have rendered valiant service. Mr. Sutton in his first year as editor has shown the enthusiasm, patience and diligence so necessary in that position and we are all reassured as to the welfare of the Journal, which must be acknowledged as the major project of the Association.

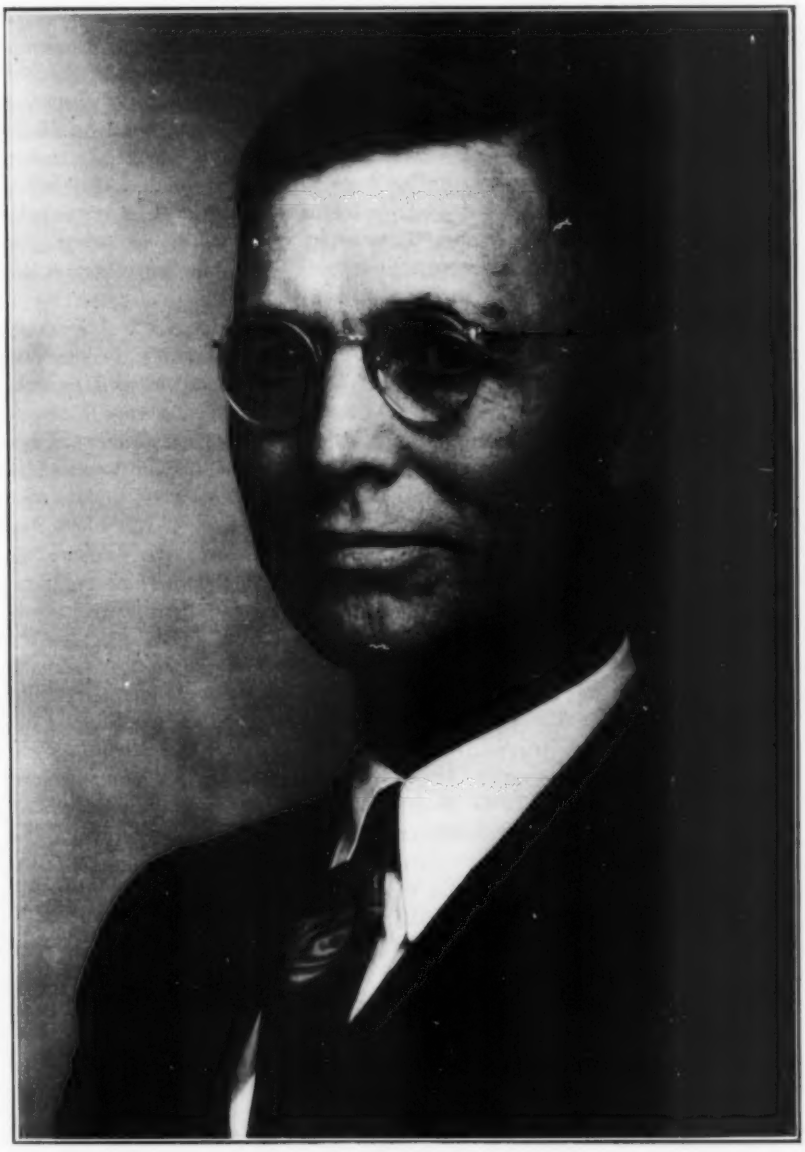
Then there is a second Journal matter which I feel has not been sufficiently emphasized to our members. Our technical workers recognize the suitability of the Journal as a medium for the publication of their results. Apparently, however, many of these workers fail to recognize the feasibility and economy in ordering liberal numbers of "reprints" for subsequent use in handling requests. Department heads and station directors should be advised of the economies possible through this procedure. The greater use of Journal reprints could save materially in printing costs to the station.

The third matter pertains to advertising. While few of us are familiar with the varied phases of advertising and in many cases are not very sympathetic, we must all realize that the advertising accounts make possible the continuance of the Journal. Our successes in selling space to those concerns more directly related to Dairy Manufactures have been gratifying. To Mr. Stoltz is due the credit for these favorable responses that have been enjoyed. However, the Journal Management Committee is faced with the problem of selling space to concerns identified with Dairy Production. Certain ones of our members, who are in a position to render service in this direction, must be called upon to help solve this problem.

Membership: The number of members in the Association at the present time is the highest we have ever had. This fine record is due to the membership chairmen in the several states. Of course, an especial concern in a membership campaign is to get new members. This year several of the states obtained in excess of 20 new members each. Ohio reported 45 and Pennsylvania took the lead with 74. The state chairman are all deserving of our praise.

A total of 387 new members was obtained. On the nomination blank which the new member submits he indicates his particular field of interest. A preponderance of the new members expressed interest in Dairy Manufactures. They out-numbered those interested in Dairy Production by nearly a 2 to 1 ratio. Every member of the Association who is able to exert some influence should encourage his friends in Dairy Production to identify themselves with the Association. There is a particular opportunity to secure members from among those qualified persons who are identified with larger farms and breeding establishments, with commercial feed companies and companies handling grinders, silo equipment and other equipment. This field for members has not yet been effectively canvassed. It offers us an opportunity.

Student Affiliates: During past years a few of our college workers have



DR. E. S. GUTHRIE, PRESIDENT ELECT

actively encouraged their students while yet in college to affiliate themselves with the Association. Some of us have been only moderately active in such a program. There are several reasons why we should encourage student affiliation. A student in college finds satisfaction in the fact he is identified with his professional society. Furthermore, upon graduation, there is an appeal for him to continue his status as an active member. A good number of student affiliates each year is a quite effective safe-guard for the Association in subsequent years. I believe we have testimony for this in our records. Those states this year which have been most successful in reporting new members are those states wherein active Junior Chapters are operating in the college or university.

A year ago President Gregory appointed a committee of J. A. Nelson, E. V. Ellington and A. A. Borland to formulate uniform rules whereby Junior Chapters could be sponsored. This committee report will be submitted for your action at the general meeting on Friday.

The Dairy Curriculum: A year ago a comprehensive committee was appointed to study the Dairy Curricula in the different institutions and if found feasible to formulate proposals that might be embraced in our constant efforts to make our courses of study fit the needs. The committee has encountered extreme diversity of opinion, which is not at all unexpected. They have a prolonged task before them but I am confident their deliberations and proposals will prove helpful to all who have responsibility in constructing our courses.

On Friday, Dr. Roadhouse of the sub-committee on the Dairy Manufactures Curriculum will present a progress report. A companion report from Professor Wylie for the sub-committee on Dairy Production will also be presented.

Regulations for the Borden Awards: During the year a committee consisting of Harold Macy, F. B. Morrison and H. A. Ruehe has assembled opinions from every Dairy Department and from individuals pertaining to the rules to be observed in the Borden Awards. This committee has its proposed rules ready for submission at the next general session on Friday; the action of the Association on these will be expected.

Members' proposals of policy changes: I have been impressed this year with the extreme interest on the part of several members of the Association as evidenced by proposals they have submitted to change some of the Association policies and invoke new ones. Those proposals always receive attention from your officers and directors. I should like to encourage all the members to submit their ideas and opinions for the betterment of the Association.

Recognition of Personnel: In attempting to handle the duties of the president's office this year I have been more forcefully impressed than ever before with some of the problems inherent in our rapidly expanding organization. Particular reference is made to the fact that our membership is not

acquainted sufficiently with their own organization and its many committees, sections and divisions.

While the situation is not unexpected we are attempting to combat it by presenting to the membership at this meeting the committeemen and the officers of the sections and divisions. We feel the service these men render is deserving of our official recognition. Furthermore, it seems entirely appropriate to make this gesture for a little wider acquaintanceship between all the members and all the officers of our Association.

In line with the same objectives we are also recognizing today the services rendered by former presidents of our Association. They have all retained their interest in the Association; many continue to render conspicuous official service. To them is due the credit for the foundation upon which our Association has been built.

Then I want to take this occasion to acknowledge the fine services the present directors and committee members have performed this year. They have been most willing to assume some tedious duties assigned them; they have accomplished their tasks most effectively. I am sure too I express to these officers the gratitude of the entire membership for the services they have rendered."

Past President H. W. Gregory was then called upon to introduce the past presidents as follows:

1907–1908	R. A. Pearson	1926	J. B. Fitch
*1909–1910	C. H. Eckles	1927–1928	G. C. White
1911–1912	O. F. Hunziker	1929	J. M. Sherman
1913–1914	J. H. Frandsen	1930	H. B. Ellenberger
*1915–1916	Fred Rasmussen	1931	E. L. Anthony
*1916–1917	Wm. A. Stocking	1932	H. C. Jackson
1918	A. C. Anderson	1933	R. B. Stoltz
1919	M. Mortensen	1934	C. L. Roadhouse
*1920–1921	C. H. Eckles	1935	H. A. Ruehe
1922–1923	A. A. Borland	1936	R. R. Graves
1924–1925	O. E. Reed	1937	H. W. Gregory

Mr. Gregory read greetings from the following Past Presidents: A. C. Anderson, M. Mortensen, J. B. Fitch, G. C. White, J. M. Sherman, H. B. Ellenberger, E. L. Anthony, H. C. Jackson, H. A. Ruehe and R. R. Graves.

He then introduced the following Past Presidents: O. F. Hunziker, J. H. Frandsen, A. A. Borland, O. E. Reed, R. B. Stoltz and C. L. Roadhouse.

Vice President E. S. Guthrie introduced the officers of the Sections and Divisions:

H. W. Cave, Chairman—A. H. Kuhlman, Vice Chairman of the Production Section.

P. A. Downs, Chairman—F. H. Herzer, Vice Chairman of the Manufacturing Section.

S. J. Brownell, Chairman—O. J. Hill, Secretary of the Extension Section.

* Deceased.

Richard E. Waters, Secretary of the Southern Division.

I. H. Loughary, Chairman—G. A. Richardson, Vice Chairman and J. O. Tretsven, Secretary of the Western Division.

President Weaver then introduced the Directors who were present:—H. W. Gregory, E. S. Guthrie, R. B. Stoltz, J. W. Linn, E. V. Ellington, Harold Macy and E. G. Hood.

President Weaver announced the following committees:

Resolutions Committee—C. Y. Cannon, D. R. Theophilus, B. E. Horrall, L. S. Palmer and Otto Hill.

Nominating Committee—H. C. Jackson, P. S. Lucas, O. E. Reed, I. R. Jones and C. A. Smith.

Committee on Borden Nominations—Prescribed by rules to consist of current chairman and two immediate past chairman of respective sections.

Manufactures:

P. H. Tracy—Chairman, Mfg. Section 1936–37.
C. J. Babcock— " " " 1937–38.
P. A. Downs— " " " 1938–39.

Production:

F. W. Atkeson—Chairman, Prod. Section 1936–37.
W. E. Krauss— " " " 1937–38.
H. W. Cave— " " " 1938–39.

Committee on Borden Awards—(Each president appoints one member to serve three years.)

Production:

H. B. Ellenberger—term expires Dec. 31, 1939; appointed by Graves.

F. B. Morrison—term expires Dec. 31, 1940; appointed by Gregory.

L. W. Morley—term expires Dec. 31, 1941; appointed by Weaver.

Manufactures:

H. A. Ruehe—term expires Dec. 31, 1939; appointed by Graves.

M. Mortensen—term expires Dec. 31, 1940; appointed by Gregory.

W. D. Dotterer—term expires Dec. 31, 1941; appointed by Weaver.

H. E. Lattig, Assistant Dean of Agriculture, University of Idaho, was introduced and read a paper entitled "Objectives of Dairy Husbandary Teaching in Secondary Schools."

E. V. Ellington, Vice Dean and Director of the College of Agriculture and Experiment Station, State College of Washington, presented a paper "Adult Education in Dairy Husbandry."

There were one hundred and sixty-nine in attendance.

GENERAL BUSINESS MEETING

AMERICAN DAIRY SCIENCE ASSOCIATION

PULLMAN, WASHINGTON, JUNE 30, 1939

President Earl Weaver called the meeting to order at 9:30 A.M. in Science Hall on the State College of Washington campus.

The secretary-treasurer read the financial report which had previously been approved by the Board of Directors. Upon motion, duly seconded, the report was accepted and referred to the auditing committee.

"February 20, 1939

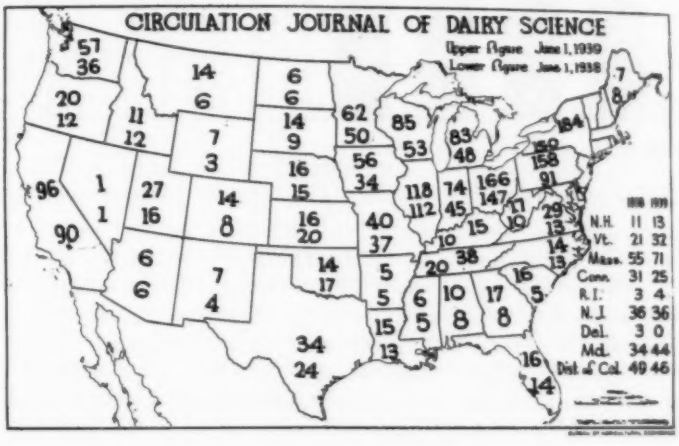
To the Members of the American Dairy Science Association
Gentlemen:

Mr. Walter C. Burnham of Columbus, Ohio, certified public accountant, has made an audit and report of the financial condition of the Association.

The Auditing Committee has conferred with Mr. Burnham and is satisfied that he has made a careful examination of all the assets and liabilities of the Association and that all the accounts are accurate. The committee is satisfied that the balance sheet and related summary of profit and loss fairly represents the financial condition of the American Dairy Science Association.

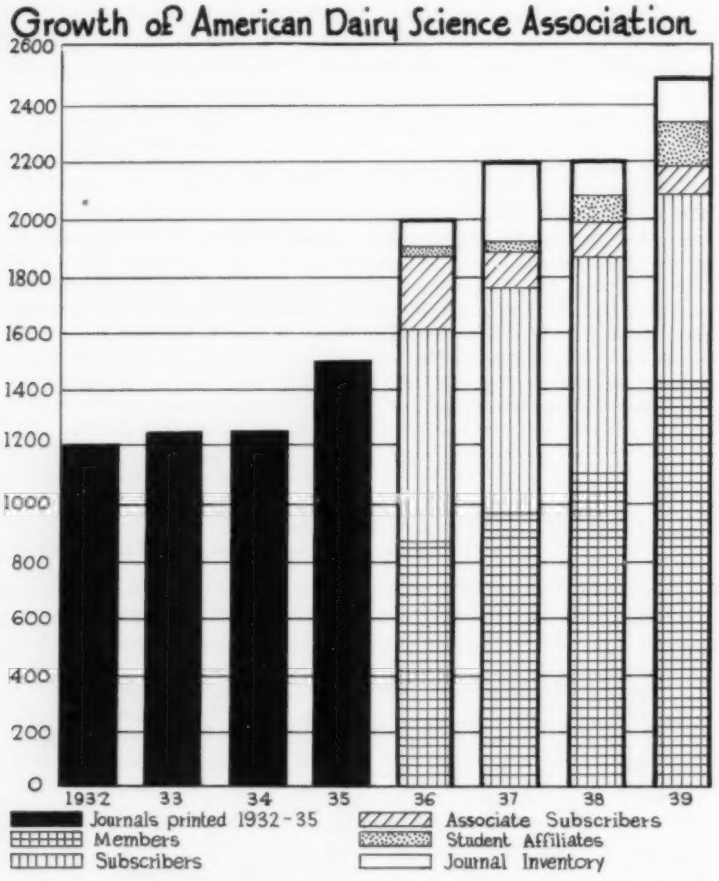
Respectfully submitted,
J. F. Lyman (Signed)
S. M. Salisbury (Signed)
L. H. Burgwald (Signed)
Auditing Committee
American Dairy Science Association"

Circulation of Journal: The secretary then called the members' attention to a chart showing the growth of circulation during the past six years. He also showed a map of the United States giving the circulation of the Journal



by states on June 1, 1938, and June 1, 1939. These figures accompany this report.

"The results of the chairman of the state campaign committees are very gratifying. May I congratulate the members who have been instrumental in bringing about the large increase of members during the past year.



Under our new constitution we are especially anxious to interest the output of the dairy schools in student affiliates. We have a total of 149 student affiliates this year and are of the opinion that we should have not less than 500. Pennsylvania has 40, Ohio 34, Tennessee and Michigan 11 each, Indiana 9, Texas 8, Vermont 6, Utah and Massachusetts 5 each. Many of our larger dairy schools do not have any student affiliates. This can be done by the faculty selling their student body on the need of their possessing their Journals of Dairy Science the same as their text books.

The success and progress of the dairy industry will depend largely upon the viewpoint that the graduates of the dairy schools of today have towards research. Research is not only for full-time men paid for that job alone, but it is for every technically trained man both in the field of dairy production and dairy manufacturing. Up to this age most research has been made on mechanical things, but the next quarter century it is going to be more complicated, requiring training in chemistry, physics, bacteriology and other technical sciences. This will require college-trained men. Do not you in the field of education feel responsible for your graduates after they leave you and enter the industry?

In order to qualify for the needs of the present and future they should be sold on the need of reading the JOURNAL OF DAIRY SCIENCE.

Advertising: Our income from advertising has been on the increase, but it is not near as much as it should be. In 1936 we had 80½ pages, in 1937, 108 pages, in 1938, 94 pages and for the first six months of 1939, 61 pages. We should be advertising equipment and supplies for the field of production. The cattle clubs and breed organizations have not seen fit to advertise in our Journal."

The Secretary then read the minutes of the Board of Directors meetings as follows:

MEETING OF BOARD OF DIRECTORS

AMERICAN DAIRY SCIENCE ASSOCIATION

8:00 P.M., June 26, 1939

A meeting of the Board of Directors of the American Dairy Science Association was held in Troy Hall, Monday, June 26, 1939, at 8:00 P.M.

Present: President, Earl Weaver; Vice-President, E. S. Guthrie; Secretary-Treasurer, R. B. Stoltz; Directors, E. G. Hood, E. V. Ellington, H. W. Gregory, Harold Macy, J. W. Linn.

Absent: Directors, C. E. Wylie, M. E. Parker.

O. F. Hunziker, Chairman of the Journal Management Committee, submitted the following report:

"Your Committee on Journal Management beg to respectfully submit the following brief report:

Journal Finances: The details of Journal Finances for the year 1938 are contained in the very complete, audited, annual report submitted to your Board by the Secretary-Treasurer, January 31, 1939.

It is significant to note here that each one of the three major sources of revenue of the Association, i.e., membership fees, subscriptions and advertisements, showed a very substantial increase over the previous year. The total circulation of the Journal for 1938 passed the 2000 mark, being 2053. The financial figures for 1938 speak for themselves. The gratifying situation which they reveal is no accident.

As to the year 1939, the prospects look indeed encouraging. The Secretary-Treasurer's office reports a total Journal circulation for this year up to June 5th of the record-breaking figure of 2285.

Editorial Department: A report of details of the editorial phase of the Journal, showing number of pages for manuscripts, abstracts, review articles, etc., distribution of articles relative to branches of industry and by States, together with numerous timely suggestions in the interest of increased service of the Journal to its readers, has been prepared by the Editor for presentation to the Board at one of the sessions of this meeting.

In the interest of economy of time the present report will, therefore, omit editorial statistics and will briefly refer to the Editor's suggestions under their respective subjects, in later paragraphs. Your committee desires to take this opportunity, however, to express our admiration and appreciation of the splendid manner in which our new editor has taken hold of his arduous task, and of his able performance of every phase of editorial duties. He has proved himself eminently qualified for the job, as tangibly demonstrated by the continued high quality of the Journal. It has been a pleasure to work with him, and he richly deserves our expression of recognition of his successful efforts.

Reprinting of Journal Articles in other Publications: Requests from other publishers for reprinting articles that have appeared in the JOURNAL OF DAIRY SCIENCE in their publications are not numerous, but whenever they occur they raise the question of Policy. It is the judgment of your committee that the occasional reproduction of Journal articles in another recognized publication, is in no way objectionable and tends to promote desirable publicity for our Journal. We feel, however, that there should be established a definite policy on this point, that has the full approval of this Board. We therefore, respectfully request that the Board of Directors take action on the following recommendations:

1. That requests for the reprinting of Journal Articles in other reputable publications be granted if printed in its entirety;

2. That the question of suitableness of the publication making the request be left to the discretion of the Secretary-Treasurer; and,

3. That the JOURNAL OF DAIRY SCIENCE insist that the author's name and the phrase 'by Permission of the JOURNAL OF DAIRY SCIENCE' appear in legible type directly under the title of the reprinted article, giving volume and inclusive paging.

Publication of Necrologies: The consideration of the publication of necrologies, and their lengths, is a problem that confronts the Journal recurrently. At times it becomes embarrassing to our editor. While it appears eminently fitting to make mention in the Journal of the passing of leaders in the dairy industry, and to do honor to the memory of members of our own Association, your committee feels that the JOURNAL OF DAIRY SCIENCE is not the proper organ for lengthy necrologies. In order to safeguard the proper purpose of

the Journal and to avoid embarrassment, your committee respectfully request that this Board give consideration to the following recommendations:

1. That necrologies acceptable for publication in the Journal be limited to members only;

2. That necrologies not exceed 1500 words; and

3. That a Necrology Committee be appointed with instructions to provide the editor with appropriate necrologies of members who have passed on, and with suitable notices of the demise of other outstanding leaders of the dairy industry.

Standardizing Style of Manuscripts: There is undeniable room for improvement of the style of the articles that reach the editor. This refers to the physical make-up of articles, tables, etc. There is need especially also for greater uniformity of style of articles and tabular material. In order to work toward constructive improvement along this line there should be prepared for the Journal a brief style standard that may be placed at the disposition of authors of articles for the Journal. This matter is referred to in more detail in the Editor's report to the Board. The Editor, in fact, recommends that a committee be appointed with instructions to prepare a brief style standard, printed copies of which may be distributed among our membership.

Your committee on Journal Management is in full sympathy with this suggestion and we beg to respectfully recommend the appointment of such a committee. We further recommend that the completed draft of the brief style standard be submitted to the Editor and to the Journal Management Committee for their approval, and that separate prints of the approved standards be supplied to the entire membership.

Changing of Abstract Page Numbers: In order to eliminate possible confusion in page numbers, between articles and abstracts, all abstract page numbers are now prefixed by the letter "A." The change commenced with the January number of the Journal, so that in the XXII volume (1939) all abstract page numbers will be found prefixed with the letter "A."

Changing Color and Style of Lettering of Cover Page of Journal: Your committee recommend that the question and character of change of color and style of lettering the cover page of the Journal be left to the discretion of the Journal Management Committee.

Respectfully submitted by

A. A. BORLAND,
R. B. STOLTZ,
O. F. HUNZIKER, *Chairman*
The Committee on Journal Management.

Upon motion duly seconded, the report was accepted.

Mr. Harold Macy, Chairman of the Committee on Borden Awards, then submitted the following report and upon motion duly seconded the report

was adopted as amended, with the understanding that it was to be printed in the Journal and reprints made for distribution:

REGULATIONS GOVERNING THE BORDEN AWARDS FOR RESEARCH IN

(*a*) DAIRY PRODUCTION
(*b*) DAIRY MANUFACTURING

FOREWORD

The Borden Company in 1936 made the following offer to the American Dairy Science Association:

"An annual award of $1,000 in cash and a gold medal is offered by the Borden Company for each of the purposes set forth herewith and administered as outlined:

(1) For work in the production field, breeding or feeding of dairy cattle, farm sanitation or quality production, etc., to be administered by the American Dairy Science Association.

(2) For work in the processing field, such as improvement in equipment or methods in the handling of milk or cream and the production of milk products, to be administered by the American Dairy Science Association."

REGULATIONS

Eligibility: To be eligible for a Borden Award, a nominee shall have made a meritorious scientific contribution, or discovery pertaining to dairy production or dairy manufacturing, or invented a plan, process or device which is useful, valuable or significant in the theory or practice of dairy production or dairy manufacturing. The work, upon which the award is to be based, must have been completed or published during the five year period immediately preceding January first of the year during which the award is to be made. Under special circumstances, consideration also may be given to related work accomplished by the nominee during a period not to exceed ten years previous to the time the award is to be made. In judging the significance of the contribution of the nominee special consideration will be given to the independence of thought and originality manifested in planning and carrying out the research, the comprehensive nature of the work and its value to the industry. Anyone is considered eligible who is a living citizen of the United States or Canada and who at the time of nomination is actively engaged in the line of research for which the award is made. There are to be no restrictions as to race, sex or age. The award may be made to co-workers when deemed advisable. Membership in the American Dairy Science Association is not a requisite of eligibility. No individual shall receive the award more than once.

Nominations: A nomination for the award may be sent to the Secretary of the Association by any member of the Association except members of the

Award Committee. Nominations must be accompanied by a brief biographical sketch of the nominee and a list of publications, with reprints if possible, or other evidence of the completion of studies, with specific reference to the research upon which the nomination is based. No member may offer more than one nomination in any given year. No solicitation on the part of any individual or institution on behalf of any nominee will be tolerated. All nominations must be in the hands of the Secretary on or before January first of the year of the award. The Secretary will transmit all nominations as received to the Chairman of the Nominating Committee of the Production or Manufacturing Section depending upon the field of study of the nominee.

Nominating Committee: There shall be two Nominating Committees of three members each, one Committee representing the Production Section and the other the Manufacturing Section, in each case consisting of the Chairman of the Section for the current year and the last two preceding Chairmen of the Section. The senior member of each Committee shall serve as Chairman of the Committee. Any vacancy on such Committees may be filled by appointment by the President of the Association. All committee members must be members of the Association.

It shall be the sole duty of each Nominating Committee to receive the respective nominations for its section from the Secretary and to canvas the field when necessary in order to see that no one who has accomplished outstanding research has been overlooked and to nominate any worthy person or persons not nominated by the members of the Association. The Nominating Committee shall ignore all unsolicited support for any nominee beyond the original letter of nomination from an individual member.

Award Committee: There shall be two Award Committees of three members each, one Committee representing the Production Section and the other the Manufacturing Section. One member of each Committee shall be appointed by the President each year for a three-year period. The senior member of each Committee shall act as Chairman of the Committee. No member of the Committee shall serve more than one term. Any vacancy on such Committees may be filled by appointment by the President of the Association. All Committee members shall be members of the Association. If the name of a member of an Award Committee is included among the nominees of the Nominating Committee, such member shall withdraw from the Award Committee for the current year and the President of the Association shall appoint a member to fill the vacancy and to serve for the current year only. Each Award Committee shall act as the sole and final judge in selecting the recipient of the award from a list of nominees submitted by the Nominating Committee of the Section involved. The Award Committee should seek further evidence from the industry as to the effect which the work of any nominee may have had upon the actual practices in the industry. If

an Award Committee shall decide that no outstanding work has been presented for its consideration, the award shall not be made. The Award Committee shall report their selection of recipients to the Secretary on or before June first of the year in which the award is to be made.

No two members from the same institution or business organization shall serve on any one Nominating or Award Committee. The President of the Association shall appoint a properly qualified member to fill any vacancy caused by the operation of this provision.

The announcements and the Awards shall be made at the Annual Meeting of the Association.

Respectfully submitted,

H. A. RUEHE
F. B. MORRISON
H. MACY, *Chairman*

The Board was then adjourned.

MEETING OF BOARD OF DIRECTORS

AMERICAN DAIRY SCIENCE ASSOCIATION

10:00 A.M., June 27, 1939

A meeting of the Board of Directors of the American Dairy Science Association was held in Troy Hall, Tuesday, June 27, 1939, at 10:00 A.M.

Present: President, Earl Weaver; Vice President, E. S. Guthrie; Secretary-Treasurer, R. B. Stoltz; Directors, E. G. Hood, E. V. Ellington, H. W. Gregory, Harold Macy, J. W. Linn.

Absent: Directors, C. E. Wylie, M. E. Parker.

Mr. John Nelson, Chairman of the Committee on Junior Chapters of the American Dairy Science Association, then gave the report of his committee, a copy of which was distributed to each member in attendance.

Upon motion duly seconded the report was accepted.

President Weaver invited the Association to meet at Michigan State College in 1942. Letters were read from Mr. Weaver, Dean Ernest L. Anthony and President R. S. Shaw confirming the invitation to meet at East Lansing, Michigan, in 1941 or 1942. It was moved and seconded that the invitation from Michigan be placed on file and a letter expressing our appreciation be sent to the Dean and President. It was thought that the Board had no right to set the place of meeting this far in advance.

It was moved and duly seconded that a letter from Professor Borland of Pennsylvania State College regarding the change of time of holding the annual meeting be answered by the secretary and that the secretary be authorized to make a survey among the various schools in regard to changing the time of holding our annual meeting.

The Board of Directors then adjourned.

MEETING OF BOARD OF DIRECTORS AMERICAN DAIRY SCIENCE ASSOCIATION

3:30 P.M., June 27, 1939
Pullman, Washington

A meeting of the Board of Directors of the American Dairy Science Association was held in Troy Hall, Tuesday, June 27, 1939, at 3:30 P.M.

Present: President, Earl Weaver; Vice President, E. S. Guthrie; Secretary-Treasurer, R. B. Stoltz; Directors, E. G. Hood, E. V. Ellington, H. W. Gregory, Harold Macy, J. W. Linn.

Absent: Directors, C. E. Wylie, M. E. Parker.

Mr. O. E. Reed then appeared before the Directors and invited the Association to meet in Washington and at the University of Maryland in 1941.

Letters were read from Mr. O. E. Reed of the U. S. Department of Agriculture, Bureau of Dairy Industry, Kenneth C. Ikeler, Head of the Animal and Dairy Industry Section and the Chamber of Commerce, Washington, D. C., confirming this invitation.

Mr. O. M. Camburn of the University of Vermont appeared before the Directors and invited the Association to meet in Burlington, Vermont, in 1941. A letter was read signed by H. B. Ellenberger of the University of Vermont giving information as to the facilities they had to offer.

Mr. J. H. Frandsen of Massachusetts State College then appeared before the Board and invited the Association to meet at Amherst, Massachusetts in 1941.

Upon motion duly seconded, the invitation from Vermont was accepted.

The meeting was then adjourned.

MEETING OF BOARD OF DIRECTORS AMERICAN DAIRY SCIENCE ASSOCIATION

9:00 A.M., June 29, 1939

The fourth meeting of the Board of Directors of the American Dairy Science Association was held in Troy Hall, Thursday, June 29, 1939 at 9:00 A.M.

Present: President, Earl Weaver; Vice-President, E. S. Guthrie; Secretary-Treasurer, R. B. Stoltz; Directors, E. G. Hood, E. V. Ellington, Harold Macy, J. W. Linn.

Absent: H. W. Gregory, C. E. Wylie, M. E. Parker.

The minutes of the three previous board meetings were read and approved.

Mr. Ellington then presented the following report for the Program Committee:

To the Board of Directors of the American Dairy Science Association

The Program Committee for the 34th Annual meeting of the American Dairy Science Association consisted of P. A. Downs, University of Ne-

braska; H. W. Cave, Kansas State College; S. J. Brownell, Cornell University and H. P. Davis, University of Nebraska; with H. P. Davis, University of Nebraska and T. S. Sutton, Ohio State University as Advisory Members and E. V. Ellington, Chairman. The first three members were members by virtue of their position as chairmen of the Manufacturing, Production and Extension Sections respectively. The personnel of this committee is selected in accordance with the recommendations of the Program Committee of 1937. The Chairman was appointed by the President of the Association on the recommendations of the Dairy Departments of the two host institutions.

The Chairman again was at a disadvantage in that the other members of the Committee were located far distant from the place of meeting. The Chairman had considerable preliminary correspondence with the other members, the concensus of opinion being that under the circumstances the local chairman would have to use considerable discretion in the preparation of the program. In order to divide this responsibility the Chairman selected three local committees on program consisting of the Production, Manufacturing and Extension members of the University of Idaho and the State College of Washington staffs.

The first call for titles of papers was made January 13, in a letter addressed to Heads of Dairy or Animal Husbandry Departments, in which the suggestion was made that each head call a staff meeting to discuss the proposed papers that might be presented from his institution. Attention was also called to them that the February number of the JOURNAL OF DAIRY SCIENCE would make the first call for papers, abstracts of which should be in the hands of the Program Chairman by April 15. Letters were also sent to the Bureau of Dairy Industry, United States Department of Agriculture.

On March 8, 1939, all members of the Association were contacted and again on March 23, the heads of departments were reminded that abstracts to be presented be in the hands of the Program Chairman by April 15.

Papers were not all received until April 17 and very few before April 14.

As a result a total of 101 papers were received, distributed as follows:

General 2, Manufacturing 37, Production 41 and Extension 21. These, with two exceptions, were included in the Association program.

The Committee commends the Extension Section on their method of organizing very definitely the type of program, and as a section, they presented to the Chairman of the Program Committee the subjects to be presented and the personnel to present them.

The Committee recommends that the Departments of Dairy Husbandry or Divisions from the various Experiment Stations exercise the same care in reviewing subject matter of the individuals presenting papers as they would if such papers were to be presented in the most conservative scientific journals. This would relieve the Committee of considerable responsibility in attempting to pass on suitability of material to be given.

Upon motion duly seconded, the report was adopted and the Board expressed their thanks and gratitude for the splendid work that the committee had rendered.

It was moved and seconded that the Board express their appreciation to the local people and that the copy of the resolutions regarding the appreciation be sent to the deans and presidents of the two institutions.

The meeting was then adjourned.

EDITOR'S REPORT

1. Summary of Journal contents.

During the past year, July, 1938 to May, 1939 inclusive, the JOURNAL OF DAIRY SCIENCE has carried 91 papers exclusive of the proceedings of the annual meeting, announcement material, necrologies, membership and circulation lists and abstracts. These 91 papers occupied 800 pages.

A classification of these papers shows that 52 papers covering 482 pages were devoted to manufacturing, 28 papers covering 212 pages to production and 8 papers occupying 66 pages were of basic interest to both divisions. In addition, two review articles have been published occupying 26 pages, also a history of the Students' National Contest in Judging Dairy Products covering 14 pages.

During the same period 126 pages have been devoted to announcement material, necrologies, membership lists, index, etc., and 232 pages were occupied by abstracts of literature. This is 1158 pages in all. This does not include the June, 1939 issue which contains the program and abstracts of papers.

2. Distribution of papers on subject matter basis.

We realize that it is difficult to classify many papers on the basis of subject matter. Some papers are of interest and contain information of value in several divisions of the industry. The classification presented here places the paper in the group where, in our judgment, it held the greatest interest.

SUBJECT MATTER DISTRIBUTION OF PAPERS

Subject Matter	*No. of Papers*
Milk	23
Chemistry and Analytical Methods	10
Butter	9
Cheese	8
Feeding, including effect on milk	8
Breeding	5
Physiology and Nutrition	5
Fluid Cream	4
Milk Secretion	4
Ice Cream	3
Condensed and Dry Milk	3

Analysis of Feeds	2
Bacteriology	2
Herd Management	2
Dairy Cattle Disease	1
Miscellaneous	2
	91

3. Contribution by states.

We thought it might be of interest, and perhaps stimulating as well, to see where the papers carried by the Journal originated. We appreciate that this sort of data, collected over a one year period, does not accurately measure the activity of a research institution. It may so happen that quite a number of investigations are completed in one year at a given institution and in the year following only a few investigations may yield data complete enough to justify publication. Again, certain institutions may not use the JOURNAL OF DAIRY SCIENCE so regularly as a place in which to publish their work, as others do, feeling perhaps that the nature of their work makes it of greater interest to other publications.

During the past year (exclusive of the June, 1939, issue) twenty-four states, the U.S.D.A. and Canada have contributed to the Journal. The number of their contributions is shown in the accompanying table:—

CONTRIBUTION BY STATES

State	*No. Papers*	*State*	*No. Papers*
New York	15	California	2
Illinois	10	Idaho	2
U.S.D.A.	7	Maryland	2
Wisconsin	7	New Jersey	2
Pennsylvania	6	Oklahoma	2
Iowa	4	West Virginia	2
Kansas	4	Canada	1
Michigan	4	Florida	1
Arizona	3	Montana	1
Indiana	3	Nebraska	1
Minnesota	3	Nevada	1
Missouri	3	Oregon	1
Ohio	3	Virginia	1

4. Review articles.

It was the original intention of those who formulated the plans for carrying review articles in the Journal that about six reviews should be published each year. We have been unable to meet with this schedule since only two review articles have been submitted to date, both of which have been published. The reviews that have been published have been so well received that we consider the project worthy of continuation. The publication of

up to six reviews a year will be provided for should they be received. We recognize that the preparation of a comprehensive review worthy of that name is a laborious and time consuming task, and to many is an added responsibility to an already heavily loaded schedule.

5. A 20 Year Index.

The Journal Management Committee is considering plans for indexing the first 20 volumes of the Journal. Believing that such an index, if properly prepared, would be a valuable contribution to Dairy Science literature we recommend that the Board of Directors consider the plan presented by the Journal Management Committee and take action as their judgment directs.

6. Suggestions for improvement.

During the past year a number of embarrassing errors have occurred in the Journal. While we are not attempting to dodge our responsibility, we do believe that some of these errors would have been avoided had the authors carefully checked their manuscript before submitting it. This is particularly true in the case of reference citations. Some errors which occur here are difficult or impossible to check accurately in the editor's office. Careful attention on the part of the contributor in checking literature citations is appreciated.

We are now checking the abbreviations of Journal names with the standard list of journal abbreviations listed in the Index Catalog of the library of the Surgeon General's Office. We trust that this detail will show more uniformity in the future. Where this publication is available we would appreciate authors using it in abbreviating journal names.

Tabular and illustrative material—The arrangement of tabular material with more thought of its reproduction on the printed page is desirable. Tabular material should be arranged so that it can be set crosswise rather than lengthwise of the printed page. Authors, because of their familiarity with the data, can do this better than anyone else. In some instances we have rearranged tabular material so that this could be accomplished; in others we were unable to do so.

I am quite certain that large tables carrying excessive amounts of detailed material are discouraging to some readers and that tables summarizing these data are more effective. The investigator who is particularly interested in the details of such work will undoubtedly be in correspondence with the author concerning details.

There are, no doubt, many who would like to see greater uniformity of style in the articles carried in the Journal. This is particularly true in case of tables and illustrative materials. We realize that considerable flexibility must be allowed because of the variation in the data presented. At the same

time there is ample room for improvement. Unfortunately we do not have a standard guide for our contributors to follow in preparing manuscripts for publication. If it is the opinion of the Association that a standard style brief for contributors to the Journal is desirable, there are two courses which we might follow. We might recommend one of the various publications now available as a standard for preparing manuscripts for our Journal, or a committee might be selected to prepare a brief style standard which could either be published in the Journal and reprinted for future distribution, or printed separately and distributed to our membership. I believe the latter plan would be preferable since it would provide an opportunity for giving specific recommendations, whereas most of the publications now available are more general in nature in order that they may be applied to a much broader scope of scientific subject matter than is carried by our Journal.

We appreciate the spirit of helpful cooperation accorded us the past year by those who have contributed to the Journal, by those who have given so generously of their time in reviewing articles, and by those who have called our attention to details which require more careful checking to avoid errors."

Respectfully submitted,

T. S. SUTTON, *Editor*

Upon motion duly seconded, the report was accepted.

Mr. C. Y. Cannon presented the following report of the Committee on Resolutions:

RESOLUTIONS

WHEREAS during this, the thirty-fourth annual meeting of the American Dairy Science Association, its membership and their families have enjoyed the courteous hospitality of the University of Idaho and its sister institution, the Washington State College and the delightful entertainment and considerate care provided by members of their faculties, their wives, their students and their office help:

THEREFORE, Be it resolved:

That the secretary of the American Dairy Science Association be instructed to express by letters to the presidents of the University of Idaho and Washington State College the thanks of the Association for their courtesies and the use of their buildings and facilities.

WHEREAS the large part of the burden of arranging for registration, lodging, entertainment and transportation was carried by the faculty members of the Dairy Departments of the two schools with their wives:

THEREFORE, Be it resolved:

That the members of the American Dairy Science Association, their wives and families hereby express to these Dairy faculty members and their wives their grateful appreciation for the large effort this has cost them.

WHEREAS the cities of Moscow and Pullman provided free access to their parks, golf courses and swimming pools for the use of members of the Association and their families, and,

WHEREAS the Potlatch Forests, Inc. kindly permitted the wives and families of the members of the Association to visit under guided direction their lumber cutting plant at Lewiston, Idaho, and provided lunch for them:

THEREFORE, Be it resolved:

That the American Dairy Science Association express its appreciation to the cities of Moscow and Pullman and to the Potlatch Forests, Inc. for their kindnesses.

WHEREAS Dean E. V. Ellington and his Program Committee have done a tremendous amount of work in arranging the programs that have been presented before the various sections at this meeting:

THEREFORE, Be it resolved:

That the American Dairy Science Association extend its thanks to the chairman and his committee for their splendid and untiring efforts.

However, whereas it appears that an unusually large number of papers appearing in the printed program have not been presented because of the absence of the authors,

THEREFORE, Be it resolved:

That the members of the Association in the future exercise greater discretion in submitting titles and abstracts to the Program Committee when there is little likelihood of the authors' being able to attend the meeting, since it is believed that the abstracts should not be regarded merely as a convenient method of securing advance publication of research in progress.

WHEREAS the Borden Company is continuing its awards in recognition of superior research in the field of dairying:

THEREFORE, Be it resolved:

That the American Dairy Science Association express its appreciation to the Borden Company for its continued interest in dairy research.

WHEREAS Mr. W. A. Wentworth of the Borden Company whose gracious presentations of the Borden Awards in past years has added so greatly to our sessions, has suffered such great loss and personal injuries preventing his attendance at this session:

THEREFORE, Be it resolved:

That the Secretary of this Association be instructed to express to Mr. Wentworth, his family and business associates our great appreciation for his services to the American Dairy Science Association and to Mr. Wentworth our sincere sympathy, our deep regret that he could not be with us this year and our best wishes for his speedy and complete recovery.

WHEREAS the Extension Section of the American Dairy Science Association has formally adopted uniform rules governing the organization and conduct of Dairy Herd Improvement Associations, Standard Cooperative Bull Associations, Artificial Breeding Associations, and Bull Studs:

THEREFORE, Be it resolved:

That the American Dairy Science Association adopt and approve the action of the Extension Section pertaining to the above rules, copies of which are on file.

WHEREAS during the past year our highly esteemed associate and active supporter of the American Dairy Science Association, H. E. Van Norman, passed away, and,

WHEREAS this Association has sustained an irreparable loss in his passing:

THEREFORE, Be it resolved:

That the Association pause in its deliberations to pay honor to this man, and,

That the Secretary be instructed to transmit a copy of these resolutions to the family of the deceased.

Respectfully submitted,

C. Y. CANNON
D. R. THEOPHILUS
B. E. HORRALL
L. S. PALMER
OTTO HILL

Committee on Resolutions

Mr. I. R. Jones gave the following progress report on curricula in dairy production:

DAIRY PRODUCTION CURRICULUM SUB-COMMITTEE PROGRESS REPORT

The Committee has issued a questionnaire of 17 questions to its members and has summarized and exchanged the answers as a guide to developing its work. Other exchanges are now in progress within the sub-committee. Some of the things which seem to indicate the trend of the study to date are as follows:

1. Objectives of instruction in dairy production should be definitely determined. These objectives should be based upon a careful study of the conditions within a state and should specifically meet the problems of the dairy industry in that state. The answers to the questionnaires indicated a belief that many of the established courses will profit by continuous revision and modernization. The training should fit into and show the relationship with all phases of life in which the average graduate in dairy production must work.

2. The basic science or fundamental courses should be carefully studied with the idea of establishing some degree of standardization. This includes consideration of the question of prerequisites.

3. There should be ample opportunity for a student to elect courses outside the field of dairy husbandry.

4. Dairy manufacturing courses should be required of dairy production

students in order to enable them to obtain a broad understanding of the problems in the dairy manufacturing field.

5. The relationship of the dairy industry to the problems of sanitation and public health should form an important part of the training in dairy production.

6. The introductory as well as some of the important advanced courses should be organized so as to be equally useful to general students in agriculture and major students in dairy husbandry.

7. Individual work or honor courses seem to have a definite place for upper class students.

It is recommended that the committee be continued so that definite reports can be presented for adoption at a later date.

Respectfully submitted,
C. E. WYLIE
J. W. BARTLETT
C. N. SHEPARDSON
T. E. WOODWARD
C. L. CLEVENGER
I. R. JONES, *Acting Chairman*

Upon motion duly seconded, the report was accepted.

Dr. C. L. Roadhouse then read the following report from the sub-committee for dairy manufacturing curricula:

REPORT OF SUB-COMMITTEE ON DAIRY MANUFACTURES CURRICULUM

AMERICAN DAIRY SCIENCE ASSOCIATION

JUNE, 1939

A study has been made of 25 dairy manufacturing curricula in colleges where dairy manufactures is taught as a major subject. The study was greatly aided by the availability of material prepared by H. B. Ellenberger, Chairman of the general committee. It has been noted that there is a great variation in the number of units required for graduation and a surprising variation in the number of units required in basic sciences, such as chemistry, physics, mathematics, bacteriology, zoology and botany. In four leading colleges the number of units required for graduation varied from 120 to 155 and the number of units of work in basic sciences varied from 18 to 50.

The committee has been interested primarily in the number of units required in basic sciences for graduates in dairy manufacturing. The majority of the members have favored a standardization of dairy manufacturing curricula in agricultural colleges to give a basic training to students and a good general education. This is especially desirable for students who undertake

graduate study in institutions other than the one in which they receive their B.S. degree.

Two points of view have been expressed concerning the curriculum in dairy manufactures.

(1) That there should be a separate curriculum for students specializing in dairy manufactures.

(2) That there should be one curriculum that would serve both the manufacturing and production fields of dairying in basic training and allow a liberal choice of electives to serve the needs of students specializing in the separate fields.

The view has been expressed that all dairy students should be required to complete courses in animal physiology, nutrition, feeding, milk production and principles of dairying and such additional courses in dairying as may be of interest to them. The manufacturing and production groups should then be required to complete all of the course offered in their respective fields.

Several points of view have been expressed by the committee and other members of the American Dairy Science Association. Further study will be required to complete a final report, but from the consideration of the subject by the present committee, it is apparent that a unification of the curricula in the various colleges would be very desirable.

R. W. Bell
A. D. Burke
C. D. Dahle
J. H. Erb
H. F. Judkins
W. V. Price
C. L. Roadhouse (*Chairman*)

Upon motion duly seconded the report was accepted.

Mr. Otto J. Hill, Secretary of the Extension Section, read the following report:

EXTENSION SECTION REPORT

The annual business meeting of the Extension Section was called to order by S. J. Brownell, Chairman, June 28 at 9:30 A.M. in the U. C. B. Building, Moscow, Idaho, with 53 attending.

During the two-day session the papers and committee reports were presented as given in the program. The sire committee report was presented by Floyd Arnold. This report was accepted with slight changes in wording.

The type classification committee report was given by A. C. Baltzer. Motion was made by G. E. Gordon and seconded by G. E. Vergeront as follows: The Extension Section advises the type classification committee to work in close cooperation with the breed relations committee during the coming year.

Election of Officers. Nominating Committee: E. J. Perry, C. L. Blackman, Ivan Loughary. Two nominees were presented, Warren Gifford and Glen Vergeront. Vergeront was elected secretary. R. G. Connelly automatically becomes chairman and O. J. Hill, vice-chairman. Motion was made by Blackman and seconded by Taylor that hereafter the number of sessions in the Extension Section be so arranged that at least one joint meeting could be held with the Production Section. The joint sessions should be of interest to both. Motion carried.

The following motion introduced by A. R. Merrill was carried:

> "Because of the increased interest in the work of the College Feed Conference Board on the part of dairy workers in the Southeast and on the Pacific Coast, I move that the Chairman of the Production and Extension Sections of the American Dairy Science Association appoint a joint committee of not less than five to make a study of the work of the Board and report at the next annual meeting on the advisability of including this work in the work of the Association. If the committee should decide that it is advisable to include the work of the Board within the Association it is asked to bring in tentative plans for its organization as a working part of the Association."

The meeting was then adjourned.

Respectfully submitted,
O. J. Hill,
Secretary.

Upon motion duly seconded, the report was accepted.

Mr. P. A. Downs, chairman of the Manufacturing Section, read the following report:

MANUFACTURING SECTION REPORT

The Manufacturing Section held its regular meetings at the appointed hour and place. Dr. P. A. Downs presided. The papers presented developed a well-balanced program which held the interest of the group as evidenced by the discussions when time permitted.

The meetings were conducted with dispatch and promptness and adjourned at scheduled time.

All papers were presented as scheduled except M1, M2, M5, M10, M29 and M37 which were read by number.

Dr. Downs appointed a nominating committee consisting of: G. M. Trout and C. L. Roadhouse, to nominate a vice-chairman and a secretary for the coming year.

Old Business:—Report of Committees

1. Committee on Chemical Methods for the Analysis of Milk and Dairy Products. G. H. Wilster reported for Prof. Thomson, chairman, a written report. Report accepted and filed.

2. Committee on Quality Program. P. A. Downs presented a lengthy progress report, submitted by W. H. E. Reid, Chairman. Report accepted and filed.

3. Committee on Judging of Dairy Products. Report submitted by G. M. Trout, Chairman. Report accepted and filed.

4. Committee on Methods of Determining the Curd Tension of Milk. A progress report submitted by L. A. Chambers was read. Report accepted and filed.

5. Committee on Score Cards for Sanitary Inspection of Dairy Farms. Report read by C. L. Roadhouse. Report accepted and filed.

6. Committee to Study Methods for Measuring the Oxidation of Milk Fat. Report of progress read by Dr. Garrett, chairman. Report accepted and filed.

7. Method for the Bacteriological Analysis of Milk and Dairy Products. Progress report read by Dr. Macy, Chairman. Report accepted and filed.

8. Committee on Methods of Measuring the Color of Milk. Progress report read by Professor Garrett, chairman. Report accepted and filed.

9. Committee on Sanitary Procedure. Professor L. H. Burgwald, Chairman. No members of committee present and report not submitted.

New Business:—

A discussion was held regarding the desirability of a possible change in the method of presentation of papers.

It was moved that a committee of three be appointed to work with the Manufacturing Program Committee to draw up possible changes in the program arrangement. Committee to be appointed by section chairman. Motion carried.

The nomination committee placed the following names in nomination for officers for the year October 1, 1939, to September 30, 1940.

Vice-chairman: C. D. Dahle, K. M. Renner.

Secretary: S. T. Coulter, R. Whitaker.

A vote by ballot was taken, and the secretary with C. L. Roadhouse and G. M. Trout acted as tellers.

The following officers were elected:

Vice-chairman: C. D. Dahle.

Secretary: S. T. Coulter.

Business session adjourned.

Respectfully submitted,

T. H. Herzer, *Vice-chairman,*
Acting Secretary of Manufacturing Section.

Upon motion duly seconded, the report was accepted.

Mr. H. A. Herman, acting secretary of the Production Section, then submitted the following report:

PRODUCTION SECTION REPORT

The Production Section held four sessions at the regularly scheduled hours and places with the Section Chairman, H. W. Cave, presiding at the opening session on milk secretion, physiology and udder diseases; A. H. Kuhlman, chairman for the pasture, hay and silage session; I. W. Rupel, chairman for the nutrition session, and H. W. Cave, chairman for the final session on Thursday afternoon, June 29th.

All sessions were well attended and considerable interest was shown in the papers presented. The papers were well prepared and very ably presented. Slides, charts and mimeographed material were used to a good advantage in many of the presentations. All but six of the forty-one papers listed on the program were presented. The printed program indicates the member who presented each paper.

The business meeting of the session of the Production Section was held at 3:30 Thursday afternoon, June 29, with 41 members in attendance. H. W. Cave, Chairman, presided and in the absence of A. L. Beam, H. A. Herman was appointed to serve as secretary for the meeting. The minutes of the 1938 meeting at Columbus, Ohio, were read and approved.

Reports were submitted by the various standing committees and approved. Copies of these reports are being placed on file.

Points of particular interest incorporated in the adopted reports are:

Breeds Relation Committee, J. W. Bartlett, Chairman (presented by H. A. Herman):

1. In cooperation with the dairy breed association officers, this committee has worked out a plan of registering offspring resulting from artificial breeding of dairy cows and has prepared a recommended service form for this purpose, as follows:—

(IMPORTANT) This form must be forwarded to the breed association within three days after the cow is inseminated. A certificate must be sent in for each insemination. (Not required where the owner of the bull is the owner of the inseminated cow.)

CERTIFICATE OF COLLECTION OF SEMEN

This is to certify that ..... took semen from the bull ..... Herd Book No. ..... Owned by .....
on date ..... This semen was placed in a sealed container marked as follows:

.....

.....

and shipped or delivered to .....

.....

(SIGNED) .....
(Owner or authorized agent)

Address .....

CERTIFICATE OF ARTIFICIAL INSEMINATION

This is to certify that ..... inseminated the female ..... Herd Book No. ..... owned by ..... with semen from container marked as follows: ..... and certified to be from sire (Name & No.) ..... on date .....

(SIGNED) .....
(Owner or authorized agent)

Address .....

Signature of witness of Insemination .....

(Owner of the Service Sire may insert name of the cow for which the semen is to be used.)

2. It was deemed unwise to make further additions to the testing rules concerning thyroxine administration so as to include certain placental extracts and cocoa meal.

3. It is recommended that it be left to the discretion of the production testing department of the breed associations as to whether surprise tests be *in addition to* or supplant the regular test.

4. The committee desires to call to the attention of the production section, as well as the respective state superintendents of official testing, that obligatory herd test retest requirements exist and the present wording of the uniform rules for herd improvement registry specifies conditions under which they apply.

5. It is recommended that the uniform rules for the herd improvement registry test concerning surprise tests be amended so as to read "one or more surprise tests with a preliminary milking *may* be made by a different supervisor during the testing year."

6. Regarding the mixing of milk for sampling purposes in the conduct of official tests, the committee feels that thorough mixing of milk is accomplished when the milk is poured from pail to pail several times.

Report of Committee on Methods of Measuring Results of Pasture Investigations, R. H. Lush, Chairman (presented by I. R. Jones).

It was recommended:

1. A further study and a revision of the 1936 report on pasture investigations as presented by a joint committee of the American Dairy Science Association, the American Society of Agronomy, and the American Society of Animal Production be made this next year.

2. It is recommended that this association committee cooperate with the American Society of Agronomy and the American Society of Animal Production and that any reports adopted be published in scientific journals of the societies in question rather than other agencies.

Committee on Standard Methods, A. E. Perkins, Chairman (presented by W. E. Peterson).

Report as prepared by Dr. C. F. Huffman on Feed and Feces Analyses presented and discussed. In view of no further reports and problems involved in presenting the extensive mass of material to the membership, it was voted to continue the committee another year in order to complete the work now under way.

Committee on Rules for Conduct of the Students National Dairy Cattle Judging Contest, I. W. Rupel, Chairman.

It was agreed that:

1. There would be no material changes made at this time in the rules for conduct of the contest.

2. At the request of Mr. Oderkirk, superintendent, it was agreed that a greater portion of the work of compilation and tabulation of contest results could be handled by the coaches.

Committee on Awards for Students National Judging Contest, A. A. Borland, Chairman.

It was recommended:

1. That the attempt to secure more scholarships for winners in the Students' National Contest be continued and the present committee continue its effort in this direction.

Dr. E. S. Savage, Cornell, introduced a motion that the chairman of the Production Section appoint a joint committee of not less than five to make a study of the work of the College Feed Conference Board and report at the next annual meeting. If the committee should decide, in view of the interest of the work of the Board, that it should be a working part of the Association that plans be inaugurated to make this feasible. Motion seconded and carried. This committee will be appointed later.

All standing committees were reappointed with their present personnel except as follows:

Breeds Relation Committee: F. W. Atkeson, Kansas, and Floyd Johnston, Iowa, were appointed for a period of three years to replace C. E. Wylie and J. G. Hays whose terms expired.

Committee on Methods of Measuring Results of Pasture Investigations changed as follows:

G. Bohstedt, Chairman
R. H. Lush
I. R. Jones
R. E. Hodgson
C. E. Bender
R. B. Becker

Committee on Standard Methods: C. H. Whitnah, Kansas, appointed on Milk Analyses to succeed A. E. Perkins. Other members remain the same, with W. E. Peterson as general chairman of the committee.

G. Bohstedt, chairman of the nominating Committee presented candidates for the offices of vice-chairman and secretary for 1940. W. E. Peterson of Minnesota was elected vice-chairman and H. A. Herman, Missouri, was elected secretary. A. H. Kuhlman, vice-chairman for this year, automatically becomes chairman for 1940.

Respectfully submitted,
H. W. Cave, *Chairman*
H. A. Herman, *Acting Secretary*

The Nominating Committee submits the names of the following men as officers of the Association: For Vice-President, Professor Harry Cave, Kansas State College; Professor C. Y. Cannon, Iowa State College.

For Directors, Charles N. Shepardson, Texas A. & M.; H. O. Henderson, University of West Virginia.

Fordyce Ely, University of Kentucky; J. W. Bartlett, University of New Jersey.

Respectfully submitted,

O. E. REED
C. A. SMITH
I. R. JONES
P. S. LUCAS

Mr. C. C. Prouty and Mr. Henry Hanson submitted the following attendance report:

	Members	*Non-Members*	*Ladies*	*Children*	*Total*
Dist. of Columbia	5	0	3	3	11
Arizona	2	0	2	0	4
California	9	1	6	0	16
Connecticut	1	0	1	0	2
Idaho	6	4	5	5	20
Illinois	4	0	3	0	7
Indiana	2	0	2	1	5
Iowa	5	0	4	3	12
Kansas	6	0	3	2	11
Kentucky	1	0	1	2	4
Maryland	2	0	1	0	3
Massachusetts	2	0	2	1	5
Michigan	5	2	6	9	22
Minnesota	7	0	6	10	23
Mississippi	2	0	3	1	6
Missouri	8	0	4	4	16
Montana	2	0	2	1	5
Nebraska	2	0	2	1	5
Nevada	1	0	0	0	1
New Jersey	2	0	1	0	3
New York	4	0	3	2	9
Ohio	9	0	8	8	25
Oklahoma	1	0	0	0	1
Oregon	10	1	4	0	15
Pennsylvania	3	1	2	2	8
So. Carolina	2	0	1	0	3
So. Dakota	2	0	2	3	7
Texas	2	0	2	2	6
Utah	5	1	2	0	8
Vermont	1	0	1	1	3
Washington	25	23	22	12	82
West Virginia	1	0	1	2	4
Wisconsin	5	0	3	3	11
Wyoming	1	0	1	3	5
Canada	8	9	3	0	20
New Zealand	0	1	1	0	2
	151	45	113	81	390

American Dairy Science Association Presented Borden Awards to S. L. Tuckey and R. E. Hodgson

at the

ANNUAL BANQUET
Washington Hotel
Pullman, Washington, June 29, 1939

E. V. Ellington, toastmaster, presented the officers and distinguished guests. He then introduced P. A. Downs, chairman of the Dairy Manufacturing Section, who made the following statement:

"According to the rules adopted by the Executive Board of the American Dairy Science Association, the Borden Award in Dairy Manufactures is awarded for outstanding research in this field. The recipient must not have reached the end of his 40th year and must have published the results of meritorious research during the preceding five-year period.

The members of the Dairy Manufacturing Award Committee of this Association have given careful consideration to all those recommended by the Nominating Committee and have unanimously chosen Dr. S. L. Tuckey to be thus honored this year.

Dr. Tuckey was selected for the honor on the contribution which he has made in the application of the X-ray diffraction analysis of dairy products.

Dr. Tuckey was born in Brown's Valley, Minnesota, August 24, 1905 and later moved to Peoria, Illinois. He received his undergraduate work at the Bradley Polytechnic Institute at Peoria and the University of Illinois where he received his Bachelor of Science degree in 1928. He was also granted the Master of Science degree in Dairy Husbandry in 1930 and the degree of Doctor of Philosophy in 1937 from the same institution.

Dr. Tuckey has contributed much to our knowledge of the crystalline structure of milk proteins and the process of cheese ripening, thus helping to supply a new tool for research workers in the dairy field. The results of his research have appeared in many articles published both in scientific journals and trade papers. He has brought honor to himself and to the institution of which he is a member through his efforts to serve the industry.

Mr. Foster, it is now my pleasure to present to you as the recipient of the Borden Award in Dairy Manufacturing, Dr. S. L. Tuckey."

"Dr. Tuckey, on behalf of the Borden Company and the 30,000 men and women who daily work with that organization, it gives me a lot of pleasure to extend to you the gold award under the direction of the American Dairy Science Association, for outstanding achievement in dairy manufacturing research.

My one regret is that Mr. Wentworth couldn't be here to present it as he has in the years gone by, but I know I present his sentiments and the heartiest congratulations of all the men in the Borden Company when I give you

S. L. TUCKEY

this gold award, which is the lasting memento of your accomplishments. And with it goes the paper award with which we hope you may purchase, and acquire, and enjoy something you have been wanting for a long, long while."

The toastmaster then introduced H. W. Cave, chairman of the Production Section, who made the following statement:

"The Dairy Production Award Committee of the American Dairy Science Association has the function of selecting the person to receive the Borden Award in Dairy Production in accordance with the rules adopted by the Executive Board of the Association. The award this year is conferred for meritorious research in the field of dairy production, the results of which have been published during the preceding five-year period by a person who has not yet reached the end of his fortieth year.

The three members of this committee, individually, gave careful consideration to all who had been recommended by the Nominating Committee and as a result have unanimously chosen Mr. R. E. Hodgson, Agent, Bureau of Dairy Industry, United States Department of Agriculture, and Dairy Husbandman, Western Washington Experiment Station, Puyallup, Washington, to be thus honored this year in consideration of the important and able investigations he has reported.

Mr. Hodgson is selected for this honor primarily because of the extensive investigations in which he has been the leader and the resultlant valuable contributions to our knowledge of the nutrient values of herbage of different kinds and their utilization by dairy cattle. The findings from researches conducted by Mr. Hodgson and his co-workers, including Knott, Murer, Ellington and Graves, have both scientific significance and practical application in relation to problems which confront the industry.

Mr. Hodgson assisted by his colleagues has made searching studies pertaining to: Factors affecting and methods of measuring pasture yields; factors affecting the availability of nutrients in pasture herbage and other roughages; methods of preserving and of determining nutrient values of various roughages; calcifying properties and milk producing values of green and dried pasture herbage, the content and utilization of carotene and vitamin A in different roughages; and the nutritive value of home-grown roughage rations for dairy cattle.

The Award Committee is pleased to present Mr. Hodgson to receive the Borden Award in Dairy Production for 1939.

Mr. Hodgson, will you please come forward to receive your award. Mr. Foster, I would like to present to you Mr. R. E. Hodgson for the award in Dairy Production."

Mr. Foster then spoke, "Mr. Hodgson, it is a distinct pleasure to welcome a prophet in his own home town and to give you on behalf of the Borden Company as a symbol of your achievement in the field of Dairy Production this lasting gold medal known as the Borden Award.

R. E. HODGSON

The production of milk and the caring for or feeding dairy cattle eventually reflects in a better economic status of the producers of milk and it must always be of greatest interest to the people of our industry, so we present to you with our company's compliments and best wishes the gold symbol and likewise the paper which means a great deal.

The Borden Company congratulates you and wishes you further success in your field of chosen endeavor. May this financial recognition of your unselfish work enable you to acquire something you have wanted but have not enjoyed. Thank you."

VOLUME XXII AUGUST, 1939 NUMBER 8

JOURNAL OF DAIRY SCIENCE

Published by the
AMERICAN DAIRY SCIENCE ASSOCIATION
R. B. STOLTZ, Sec.-Treas.
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Prussian Dairy Research Institute, Kiel, Germany

State Agricultural Colleges and Experiment Stations

The Royal Technical College, Copenhagen, Denmark

United States Department of Agriculture

ABSTRACTS OF LITERATURE

BACTERIOLOGY

310. Determination of the Heat Resistance of Non-spore-forming Bacteria. E. E. Baker and L. S. McClung, Division of Fruit Products, Univ. of California, Berkeley, Calif. Food Research *4:* 1, 21, 1939.

In this comparative study of technics for determining the heat resistance of non-spore-forming bacteria, evidence is presented showing the necessity for close spacing of heating periods, for long heating periods and for the heating of several tubes at each heating period. It is stated that much of the earlier work on this subject can be criticized because of failure to observe these essential points of technics. F.J.D.

BUTTER

311. Effect of Variation in Churning Acidity on Manufacture of Butter. E. W. Bird, Dept. of Dairy Ind., Iowa State College, Ames, Iowa. Nat. Butter and Cheese J., *30:* 1, 16, 1939.

The effects of acidity on cream constituents during churning can be attributed to the changes that occur in the casein. Fat losses tend to be lowest when the fresh butter serum has a pH of 6.5 to 7 and when titratable acidity of the neutralized cream approximates 0.16 to 0.18 per cent.

Approximate pH values of butter serum associated with flavor defects are:—above 7.5—alkaline or neutralized; 6.8 to 7.4—least objectionable flavors with "old cream" predominating; below 6.8—old cream, high acid and sour, show and become more pronounced; below 6.6—metallic flavors; 5.8 to 6.2—cheesy; below 6.0—fishy. W.V.P.

312. Les Phosphatides dans le Résidu du Beurre. (The Phosphatides in the Residue of Butter.) B. Rewald. Le Lait, *19:* 22–25, 1939.

Pure butter oil is produced in some European countries. In this process, the moisture is driven off and a residue settles out. The fatty materials can be extracted from this by means of petroleum ether and acetone. The extract is a mixture of lecethin (soluble in alcohol) and cephalin (insoluble in alcohol) as well as some other material. All the phosphatide extracts present are of the monoamino-monophosphatide type having a P/N ratio of approximately 1/1. O.R.I.

313. The Phosphatase Test—Its Application to Sour Cream and Sour Cream Butter. E. H. Parfitt and W. H. Brown, Purdue University, Lafayette, Ind. Nat. Butter and Cheese J., *30:* 1, 12, 1939.

The phosphatase test is in general a good tool to use to control the pasteurization of cream for buttermaking and to detect butter made from inadequately pasteurized cream. Application of this test to sour cream and sour cream butter to determine adequate pasteurization is more complex than its application to sweet products. Some of the factors which complicate the procedure are: variations in the concentration of enzyme in cream; the inactivation of the enzyme with time and temperature of storage; the insulating action of milk fat; the existence of phenol-producing bacteria; the possibility of phenol in the wash water; the use of chlorinated wash water; the activation of the enzyme in butter during storage; and the concentration of the enzyme in the buttermaking process. W.V.P.

314. How Butter Consumption Varies. MARVIN A. SCHAARS, Univ. of Wisconsin, Madison, Wis. Nat. Butter and Cheese J., *30:* 3, 8, 1939.

Various studies show that butter consumption per capita varies with nationality, race, number of adults and number of children in a family. High consumption per capita is associated with high income, small families, families of adults only and with Americans or native whites; low consumption with low income, large families, families with children, and the Negroes and people, like Italians, who use oil in place of butter for cooking. Annual per capita consumption in the United States for 1937 was 16.7 pounds. A survey of the white population is cited which shows the annual per capita consumption by regions of the United States to approximate: N. Atlantic, 21 lbs.; E. N. Central, 15.3 lbs.; E. S. Central, 18.4 lbs.; Pacific, 22.1 lbs. Negroes of South average about 6.6 lbs. per person per year. W.V.P.

315. Making America Safe for Butter or Worse. H. A. BENDIXEN, State College of Washington, Pullman, Wash. Nat. Butter and Cheese J., *30:* 3, 10, 1939.

In order to keep the consumer buying butter it is necessary to advertise its food value, flavor, and healthfulness. Consumer desires in flavor, body, salt content and package should be studied. Selling by some government established grade will stimulate consumer confidence. Some advice on controlling butter quality is given. W.V.P.

316. Dichlorofluorescein to Estimate Salt Content of Butter. F. M. SHELTON AND L. R. BRYANT. Nat. Butter and Cheese J., *30:* 4, 16, 1939.

Dichlorofluorescein, an adsorption indicator, produces a distinct and sudden color change end point when a salt solution is titrated to neutrality with silver nitrate. Dichlorofluorescein and potassium chromate were com-

pared as indicators in analyzing butter for salt. The new indicator checks very favorably with potassium chromate and gives more uniform results. W.V.P.

317. **A Study of Roll-less Churns.** C. H. PARSONS, Swift & Co., Chicago, Ill. Nat. Butter and Cheese J., *30:* 5, 12, 1939.

In the new types of roll-less churns churning time is shortened, residual butter fat in the buttermilk is no higher, working time is the same, the butter contains less air, and moisture and salt are more uniformly distributed. The new-type churn is more flexible in capacity and is decidedly more sanitary than the old type. It is hazardous to draw conclusions on such new equipment but the roll-less churn at present will justify unbiased investigation. W.V.P.

CHEESE

318. **Determining Salt Content of Cheese.** O. R. OVERMAN AND BURTON F. WHITMORE, Univ. of Illinois, Urbana, Ill. Nat. Butter and Cheese J., *30:* 2, 18, 1939.

A procedure is given for measuring salt in cheese by digesting the cheese in a side arm distilling flask with strong (35 per cent) sulfuric acid and absorbing the liberated hydrogen chloride in a measured volume of a standard solution of silver nitrate. The method is simple, short and checks closely with the official method. W.V.P.

319. **Le Dosage de la Matière Grasse dans les Fromages. (The Determination of Fat in Cheese.)** D. FLORENTIN. Le Lait, *19:* 25–29, 1939.

In an examination of three methods for determining fat in cheese the use of the Soxhlet extraction method was found to give higher values than did other methods in which the cheese was first digested with concentrated hydrochloric acid. Digestion with acid was shown to hydrolize the fat to some extent and the glycerol and soluble fatty acids thus produced were lost in the washing which preceded the final ether extraction. O.R.I.

320. **Proposed Changes in Scoring Cheddar Cheese.** J. C. MARQUARDT, New York Agr. Exp. Sta., Geneva, New York. Nat. Butter and Cheese J., *30:* 4, 12, 1939.

Cheese flavor should be added to the score card and designated as "lacking," "mild," "good," "clean," or "strong"; or, these characteristics should be given a numerical rating of 50, 60, 75, and 95 respectively. It is proposed to reduce score for finish from 15 to 10 points and to use the five points to describe salt content, as determined by chemical analysis. W.V.P.

321. Suggested Standards for the Cheese Industry. RAYMOND MIOLLIS, Natural Cheese, Inc., Chicago, Ill. Nat. Butter and Cheese J., *30:* 3, 64, 1939.

Laws controlling cheese composition should be simplified by defining varieties by classification, specifications and nomenclature rather than by percentage of fat and moisture. The manufacture of raw-milk cheese should be prohibited and strict rules should regulate cheese processing.

W.V.P.

322. A Vat for Experimental Cheese. C. B. LANE, Iowa Agr. Exp. Sta., Ames, Iowa. Nat. Butter and Cheese J., *30:* 2, 32, 1939.

Specifications are presented for the construction of a multiple cheese vat in which 20 lb. lots of milk can be given identical curd making treatments.

W.V.P.

323. Flavor Contributors of Swiss-Type Cheese. F. J. BABEL AND B. W. HAMMER, Iowa Agr. Exp. Sta., Ames, Iowa. Food Research, *4:* 1, 81, 1939.

Swiss-type cheese with considerable of the characteristic sweet flavor yielded a much higher volatile acidity on steam distillation than cheese lacking in flavor. Added calcium or sodium propionate gave to process Swiss-type cheese a sweet flavor and a texture and color more like natural Swiss cheese. The results obtained suggest that propionates are important flavor contributors of Swiss type cheese. J.F.D.

CONCENTRATED AND DRY MILK; BY-PRODUCTS

324. Fluorosis in Rats Due to Contamination with Fluorine of Commercial Casein. The Effects of Darkness and of Controlled Radiation upon the Pathology of the Teeth. HAROLD C. HODGE, ETHEL M. LUCE-CLAUSEN, AND ELIZABETH F. BROWN, Univ. of Rochester, Rochester, N. Y. J. Nutrit., *17:* 333–346, 1939.

Rats which received a diet containing commercial casein contaminated with fluorine manifested the usual tooth changes associated with fluorosis. The casein contained 0.2 per cent fluorine while the diet contained only .03 per cent. Spectrograph analysis of both commercial and purified casein obtained from several different companies showed them free of fluorine.

C.F.H.

325. Nouvelles Études sur le Dosage des Matières Minérales des Caséines Lactique. (New Studies on the Amount of Ash in Lactic Acid Casein.) JEAN PIEN AND M. WEISSMANN. Le Lait, *19:* 15–22, 1939.

Methods for the ashing of casein which will retain the organic P_2O_5 are discussed. The authors suggest the use of five grams of ground casein as a sample plus 5 ml. of a 10 per cent solution of magnesium acetate in order that the organic P_2O_5 may not be lost in the ashing. The addition of H_2SO_4 to facilitate the ashing of casein is condemned. O.R.I.

DISEASE

326. A Comparison of Cultural Methods in the Diagnosis of Bovine Mastitis. T. L. JONES AND F. W. SCHOFIELD, Dept. of Bact., Ont. Veterinary Coll., Guelph, Ont. Canad. Pub. Health J., *30:* 46, 1939.

Attempts were made to simplify several of the more reliable, but time-consuming tests for mastitis. A comparison of the growth produced from centrifuged cream layers as against the centrifuged sediment showed that the former was unreliable. Experiments were also made to determine whether or not the addition of the dye in the Hotis and Miller test inhibited bacterial growth. While no evidence of inhibition was obtained, the authors suggested that the dye be added 5 to 10 hours after incubation has begun. O.R.I.

327. Observations on a New Test for the Presence of Mastitis in Milk. W. H. WHITESIDE, Kennedy Biological Laboratories, Otterville, Ont. Canad. Pub. Health J., *30:* 44, 1939.

It was found that the addition of 2 cc. N.NaOH to 10 cc. of milk of cows suffering from mastitis produced a viscid mass when stirred with a glass rod. The test fails if the mixture is brought to the boiling point.

This test becomes positive before the brom-thymol blue and strip-cup tests. It is invariably negative with the milk of uninfected cows.

If the mixture is incubated at 37° C., it develops a bright cherry red color, probably due to the presence of acetyl amines derived from muco-proteins. O.R.I.

FOOD VALUE OF DAIRY PRODUCTS

328. Nutritional Effects of the Addition of Meat and Green Vegetable to a Wheat-and-Milk Diet. Experiments with Rats. H. L. CAMPBELL AND H. C. SHERMAN, Columbia Univ., New York City. J. Nutrit., *16:* 603, 1938.

The complete life cycles were studied in 70 and 69 male and 103 and 105 female rats on two comparable diets, one differing from the other by the addition of fresh meat and green beans to the dry diet. The criteria which were used afforded measures of the diets in relation to growth and development, adult vitality, and length of life.

The addition of fresh meat and green beans was found to result in more rapid early growth, attainment and maintenance of larger adult size, and earlier maturity. It also prolonged very slightly the period of adult vitality as measured by the ability of the females to bear young. It did not significantly influence the length of life. L.A.M.

329. Anomalies in the Bio-Assay of Vitamin D Milk. KENNETH MORGAREIDGE AND BRIAN O'BRIEN, Univ. of Rochester, Rochester, N. Y. J. Nutrit., *16:* 395, 1938.

Experiments are described which show that skimmed milk which has been fortified with vitamin D by the addition of concentrates exhibits, on bio-assay, an enhanced apparent potency which is approximately three times greater than the value expected, based on the amount of concentrate added. Furthermore, it is shown that feeding the concentrate and the skimmed milk separately to the same rats results in less enhancement of potency than does feeding the concentrates in the form of fortified skimmed milk. Milk also enhances the potency of the international standard solution of vitamin D. L.A.M.

330. The Biological Value of Milk and Egg Protein in Young and Mature Rats. EMMA E. SUMNER, Univ. of Rochester, Rochester, N. Y. J. Nutrit., *16:* 129, 1938.

The biological value of whole egg protein is higher than that of whole milk, whether determined by the paired feeding or by the balance sheet method on young or adult rats. Feeding at an 8 per cent level in the diet, the biological value is higher for both egg and milk in young rats than in the year-old animals. In adult rats the biological value for egg and milk proteins is higher at the 5 per cent than at the 8 per cent level of protein in the diet. These facts lead to the conclusion that the protein requirement for growth in young rats and for maintenance in adult rats is not the same. Less protein of good quality is required for the maintenance of mature rats, than for growth in the young. L.A.M.

331. The Availability of Calcium in Spinach, in Skim Milk Powder and in Calcium Oxalate. B. W. FAIRBANKS AND H. H. MITCHELL, Univ. of Illinois, Urbana, Ill. J. Nutrit., *16:* 79, 1938.

In comparison with dried milk the calcium of spinach, in either the fresh, cooked, (open kettle), or canned form, is very poorly utilized for the maintenance and growth of rats. In all probability it is quite unavailable under conditions permitting a very high utilization of milk calcium. Calcium oxalate appears to be entirely unutilizable by the growing rat. L.A.M.

332. Vitamin D and Dental Decay. Milk Dealer, *28:* 6, 62–64, March, 1939.

A review of the literature on the relation of Vitamin D to dental decay. C.J.B.

333. The Calcium Requirements of Pre-School Girls. J. Outhouse, G. Kinsman, D. Shelden, I. Twomey, J. Smith and H. H. Mitchell, Univ. of Illinois, Urbana, Ill. J. Nutrit., *17:* 199–211, March, 1939.

Calcium balances were determined on five children during four periods of 4 to 11 weeks each. The maximum average calcium retentions, ranging from 84 to 154 mg. daily, were attained on a calcium intake not greatly in excess to 600 mg. daily by four of the subjects. These subjects received 440 cc. of milk daily. The fifth child apparently needed slightly more, possibly as much as 490 cc. of milk daily. C.F.H.

334. The Lactation-Promoting Effect of l-cystine when Fed with Alfalfa Proteins. L. D. Wright and J. R. Haag, Oregon Agr. Exp. Sta., Corvallis, Ore. J. Nutrit., *17:* 263–268, March, 1939.

Alfalfa leaf meal containing 0.37 and 0.18 per cent organic sulphur was fed as 50 per cent of the diet of mother rats. The addition of 0.4 per cent l-cystine to this diet usually increased food intake, approximately doubled the rate of gain of the nursing young, and reduced the body weight of the lactating females approximately 50 per cent.

These results may not apply to practical alfalfa feeding problems, since the level of protein used in this study was only 9 per cent as compared with 12 to 15 per cent level commonly found in alfalfa hay. C.F.H.

335. A Study of Breed and Seasonal Variations in the Ascorbic Acid Content of Certified Milk from Guernseys and Holsteins. A. D. Holmes, F. Tripp, Research Labs., E. L. Patch Co., E. A. Woelffer, H. P. Hood and Sons, Boston, Mass., G. H. Satterfield, Univ. of North Carolina, Raleigh, N. C., J. Nutrit., *17:* 187–198, Feb., 1939.

Six hundred and sixty-one samples of certified milk collected at bimonthly intervals from 55 Guernsey and Holstein cows over a 52 week period indicated a seasonal variation in the ascorbic acid content of milk. The largest amount of ascorbic acid was found in milk produced during February. A second period of high ascorbic acid content occurred in early November.

The ascorbic acid content of Guernsey milk varied from 17.76 to 23.37 mg., and for Holstein milk from 15.72 mg. to 20.44 mg. per liter. The total yearly average for the Guernsey milk was 20.54 mg. of ascorbic acid whereas that of the Holstein milk was 18.17 mg. per liter.

The ascorbic acid content of November certified milk was independent of the ration and period of lactation. The results indicate that the generous consumption of raw certified milk can contribute materially to the vitamin C content of the human dietary. C.F.H.

336. The Biological Value of Milk and Egg Protein in Human Subjects. EMMA E. SUMNER AND J. R. MURLIN, Univ. Rochester, Rochester, N. Y. J. Nutrit., *16:* 141, 1938.

The superiority of egg protein over milk protein is less pronounced in the adult human subjects than in young or mature rats. Under the conditions of this experiment, the biological value of milk or egg protein for maintenance in adult human subjects, is lower than observed for maintenance in adult rats, notwithstanding that it was fed to human subjects at a lower level. The proteins of milk and egg are equally well utilized by human subjects or by rats, whether measured by the apparent or true coefficient of digestibility. Egg protein is only slightly superior to milk in replacing nitrogen at the 3 and 4 per cent level in human subjects.

L.A.M.

ICE CREAM

337. Dry Skim Milk in Ice Cream. C. D. DAHLE, Dairy Department, Pennsylvania State College, State College, Pa. Ice Cream Field, *33:* 4, 15, 32, 33, 36, 52, 53, 1939.

The author points out the fact that skim milk powder is often used as an ingredient in ice cream. He gives the result of some experiments in which spray powder, vacuum drum powder and atmospheric drum powder are compared one with another and also with condensed skim milk as ingredients of ice cream.

He found a difference of over three minutes in freezing time between mixes using spray process powder and atmospheric roller process powder, and three minutes between the vacuum drum and atmospheric roller process. The scores of the samples five days after making showed that on the average the spray process and vacuum drum process powders gave ice cream of higher quality, but in cases where the powder supplied only a small part of the serum solids the samples containing atmospheric powder sometimes scored as high. When ice cream is held for two months, the difference in scores is not so pronounced, in fact the ice cream made from the condensed milk deteriorated most during such storage. In most cases the ice cream scoring the highest loses the most in score after storage.

The most outstanding difference found due to powders occurred in their physical properties. In mixes containing atmospheric powder the viscosity was greater, the freezing time longer, the acidity higher, the maximum

overrun lower and the time required to reach the maximum overrun was also longer. From the point of view of freezing time the spray powder and vacuum drum powder mixes proved very satisfactory and were superior to condensed milk samples which served as the controls.

It is pointed out that these findings are in general agreement with those reported by other investigators. A brief review of some of the results of previously published work is also given. W.C.C.

338. Practical Standardization of Ice Cream Mix with the Aid of the Dairyman's Slide Rule. B. I. MASUROVSKY. Ice Cream Trade J., *35:* 5, 39, 1939.

Directions are given for the operation of the Dairymen's Slide Rule. With this instrument, it is possible to save time on the solution of milk and cream standardization problems, calculation of ice cream mixes, etc. W.H.M.

339. Retail Store Accounting and Control. ROBERT SUTTLE. Ice Cream Trade J., *35:* 5, 66, 1939.

In this the second of a series of articles on retail store accounting, are given an inventory record for supplies other than containers, and directions for keeping this record. An employee's pay roll card is also given, which is designed to give the store manager a complete record of labor cost for a given period of store operation. W.H.M.

340. Sterile Single Service Wins Place in Sanitary Control. MARY B. ZEVIN. Ice Cream Trade J., *35:* 5, 34, 1939.

Recently there has been put on the market sterile wooden forks and spoons which are wrapped individually, protected for individual use by glassine bags, or by dispensers to assure continued sterility to the point of use. Health departments, sanitary inspectors, proprietors and the public will no doubt appreciate the merits of these sterile, attractive and economical wooden utensils. W.H.M.

341. The Selection and Use of Flavor in Making Chocolate Ice Cream. W. H. MARTIN, Ice Cream Trade J., *35:* 5, 25, 1939.

This article discusses the various types of chocolate flavor. Types of beans, preparation of chocolate products, composition of chocolate flavoring materials, preparation of chocolate syrup, amounts of flavor to use, preparations of chocolate mixes, freezing chocolate ice cream and how to overcome defects are included in the discussion. Formulae are also given for several special chocolate flavored ice creams. W.H.M.

342. Sherbets. MAL PARKS. Ice Cream Trade J., *35:* 4, 57, 1939.

It is the belief of the author of this article that there is a potential consumer demand for increased consumption of sherbets. The introduction of new sherbet flavors, combination deals which feature sherbet with ice cream, and the more extensive use of sherbets in fountain dishes, were recommended. New uses of sherbets in ice tea, in fountain specials and with meals, have resulted in increased sales. W.H.M.

343. Retail Store Accounting and Control. ANONYMOUS. Ice Cream Trade J., *35:* 4, 30, 1939.

Successful and profitable operation of retail outlets demand informative and timely reports. A retail store report, and directions for its use are presented. The daily report reflects the sales, and inventory of ice cream and sherbet by flavors. From this report the operator can determine the total dollar value of sales and also the value of sales according to different types of sales. The report can be filled out daily by the store manager, and summaries may be made at ten day intervals and at the end of the month. W.H.M.

344. Improvement in Edible Gelatin through Bacteriological Control. R. H. THEXTON, Div. of Bact., Science Service, Dept. of Agr., Ottawa, Canada. Canad. Pub. Health J., *30:* 24, 1939.

In 1935 the Canadian Federal Department of Health passed regulations stipulating that the total bacteria count on food gelatin must not exceed 10,000 per gram with the absence of coli-aerogenes from 1/100 gram. A survey of the bacteriological quality of gelatin imported since these standards were adopted, reveals that gelatin manufacturers have been able to satisfy them in the great majority of cases. O.R.I.

345. Vanilla. R. ROSENBAUM, David Michael & Co. Ice Cream Field, *33:* 4, 10–12, 1939.

The author points out the inadequacy of the present legal standards in protecting the users of vanilla extracts and flavorings. He claims that present methods of chemical analysis are not sensitive enough to detect certain of the flavoring constituents in the small concentrations in which they occur in vanilla flavors. Although the standard tests for vanillin content, "lead number," etc., are made these tests are not sufficient so far as evaluating the flavor. He advocates the use of an educated "taster" as a necessary supplement. It is also claimed that with this organoleptic test in conjunction with regularly used chemical analysis, manufacturers should be allowed to standardize the vanillin content of the vanilla flavors without being forced to label them as synthetic or artificial. W.C.C.

346. Dry Ice. ANONYMOUS. Ice Cream Field, *33:* 3, 9–13, 1939.

A brief review is given of the development of solid carbon dioxide as a refrigerant and many of its applications to the ice cream industry are mentioned.

Refrigerating packages, trucks and dispensing cabinets seem to be the most likely potential uses of "dry ice" in the ice cream industry. Some of the detail problems in each of these fields are discussed. W.C.C.

347. Frosted Foods. LUIS GIBSON, George Gibson Co. Ice Cream Field, *33:* 2, 19–21, 1939.

Several large dairy organizations and a few ice cream manufacturers are already in the frosted food business.

Ice cream is sold mostly during the summer; frozen or frosted foods are sold mostly during the winter. In addition both require storage and delivery at low temperatures. The author states that already the annual production of quick frozen foods is approximately $100,000,000. It is claimed further that the frozen foods business may start by filling in ice cream off seasons, whereas later it may be that ice cream will fill in the off season for quick frozen foods.

State laws have in certain instances prohibited the use of ice cream cabinets for other frozen foods. It is claimed that certain of these laws are in the process of revision so as to permit both these products being stored in the same cabinets.

The frozen foods industry has many problems not common to the ice cream industry. It is necessary to anticipate the demands almost a year ahead. To insure the desired quality correct variety and grade as well as treatment before and during freezing are necessary. In addition proper storage and handling to the time of consumption are imperative. The author suggests that to begin with one should handle a suitable brand of frozen foods rather than try to develop and sell his own brand. Frosted foods are relatively unknown consequently the dealers, retailers and consuming public must be educated to appreciate the merits of such products.

The basic principles of merchandizing must be employed if success is to be expected. Proper display is very important, especially since the products are relatively unknown. W.C.C.

348. Ice Cream Sanitation. C. A. ABELE, Director, Division of Inspection, State of Alabama. Ice Cream Field, *33:* 2, 37–41, 1939.

The author points out that the ice cream industry has made considerable progress in sanitation and its regulation. He claims that a large proportion of ice cream plants now operating in Alabama would have little difficulty in attaining a Grade A rating. The contemplated Grade A ordinance for that

state prescribes that an ice cream plant or establishment freezing ice cream elsewhere than in the plant in which the mix is made shall obtain the mix in sealed containers holding just a sufficient quantity for one freezing batch.

Results of bacterial counts on 560 samples of ice cream and sherbet and mix in various stages of manufacture were presented. One set of comparisons are given in the following table.

Comparison of Commercial and Counter Freezer Ice Cream

	No. of samples	Arith. ave. bact. count	Log. ave. bact. count	% of counts under 30,000	% of counts 100,000 or less	% of counts 500,000 or over	% of counts 1,000,000 or over
Commercial Ice Cream	117	154,400	52,000	37.6	65.8	7.8	3.4
Counter Freezer Ice Cream	171	540,200	92,000	32.2	52.1	21.0	15.2

The temperature at which ice cream mix is held in storage was checked on 117 samples. It was found that 3.4 per cent were below 30° F., 23.9 per cent were between 31° and 40° F., 35.9 per cent were between 41° and 50° F. (i.e., 63.2 per cent at 50° F. or below) and 36.8 per cent were above 50° F. with 3.5 per cent above 60° F. The importance of controlling the temperature during transit is emphasized. W.C.C.

349. Lockers Built in Ice Cream Plant. ANONYMOUS. Ice Cream Field, *33:* 4, 16, 17, 1939.

A description is given of a recent installation of cold storage lockers by Johnson Ice Cream Co., West Union, Iowa. The lockers are installed in a room with a flooded ammonia cooling unit manufactured by the King Ventilating System. The cooling unit is centrally located with a blower and ducts diverting the freezing air to four separate rooms. Temperature in the locker room is kept at 12 to 15° F., the quick freezing room at – 20 to – 10° F., the chilling room at 36–40° F. and the fourth room is the ice cream hardening room. The plant has 320 lockers with provision for the installation of 120 more.

Although there are many other cold storage locker systems it is claimed that this is the only one with this particular system of refrigeration.

W.C.C.

350. Use of Stabilizers in Unagitated Ice Creams. LILLIAN S. BENTLEY AND BETTY M. WATTS, Dept. of Household Science, Univ. of California, Berkeley, Calif. Food Res., *4:* 1, 101, 1939.

In this study it was found that the stabilizers giving best satisfaction in commercial ice cream are not necessarily the ones producing the best results

in unagitated refrigerator ice cream. Agar combined with dry skimmilk produced a coarser texture although considered satisfactory. Pectin gave good results although a flavor effect was noted. Rennet, India gum, egg yolk, cornstarch, etc., were not considered particularly satisfactory. F.J.D.

MILK

351. Recherches sur le Pasteurisation des Laits de Consommation. (Studies on the Pasteurization of Market Milk.) G. GUITTONNEAU, G. MORQUOT AND E. EYRARD. Le Lait, *19:* 113–139, 1939.

Fifty-six strains of the *Escherichia-Aerobacter* group were isolated and submitted to different cultural tests. The A.P.H.A. Brilliant Green 2 per cent Bile medium was found to be a reliable method of detecting all strains. The chief source of *coli* contamination in the raw milk supply was found to be utensils, coolers and cans. In an investigation of high temperature, short time pasteurization, the source of *coli* in raw milk was found to be the result of incomplete sterilization of equipment before use, and recontamination by raw milk, rather than by heat resisting types of organisms surviving this method of pasteurization. O.R.I.

352. The Present Day Challenge to Milk Distribution. HARRY L. GUSTAFSON, Secretary, Association of New England Milk Dealers. Milk Dealer, *28:* 6, 84–90, March, 1939.

A discussion is given of the attacks on business which are challenging our present system. The discussion is summarized as follows:

The present day challenge to milk distribution is to tell the facts about the industry and the product it sells.

The challenge comes from employees, producers, consumers, and other distributors.

The facts are available through agencies which the industry has established. Every unit has the responsibility of presenting these facts to the public. It is a challenge which calls for the talents and energies of every man. The time for action has arrived. Let us go forth with the firm conviction that voluntary organization and cooperation under democratic processes in the American fashion is the more permanent and satisfactory way of achieving greater prosperity for all. C.J.B.

353. Sanitation of Paper Milk Containers. J. R. SANBORN AND ROBERT S. BREED, New York State Exp. Sta., Geneva, N. Y. Milk Dealer, *28:* 7, 36–37, 88–90, April, 1939.

A report of a laboratory study of paper milk containers is given. Tables are presented showing the rinse counts obtained from various types of containers as well as the bacterial counts per gram of disintegrated paperboard

from which such containers are made. The data show that paper containers can meet much more severe rinse count standards than the average glass bottle, provided the paper containers are properly handled and stored between the time when they are manufactured and the time when they are filled with milk. C.J.B.

MISCELLANEOUS

354. Preserving Cream with Salt. ANONYMOUS. Nat. Butter and Cheese J., *30:* 3, 26, 1939.

O. E. Williams, Bureau of Dairy Industry, U. S. Dept. of Agriculture, Washington, D. C., has invented a method of preserving cream at room temperatures 64° F. dissolving in it about 7 per cent of its weight of sodium chloride. The salted cream can be made practically salt free by mixing it in equal proportions with milk, heating to about 120° F. and separating the mixture to form plastic cream which is then diluted with an equal amount of milk before pasteurizing. The salted cream can be pasteurized and then churned directly into butter. This salt-preserved cream has been used successfully for coffee cream and for making ice cream. Salting lowers the freezing point so that the properties of the cream will not be changed at 0° F. W.V.P.

355. Locker Plant Construction and Design. LE ROY STAUNTON. Celotex Corp., Chicago, Ill. Nat. Butter and Cheese J., *30:* 5, 44, 1939.

Refrigeration engineers have standards for design which give sound construction and prevent avoidable losses. A few are mentioned. W.V.P.

356. Agriculture's Cinderella—The Dairy Goat. F. A. KONIG, Milkdale Farms, Newton, Conn. Milk Dealer, *28:* 6, 80–82, 1939.

A description of the Milkdale goat dairy and a discussion of the goat as related to the dairy industry during the past, present, and future. C.J.B.

357. A Conspiracy Against Business? EDWARD FISHER BROWN, Executive Vice President, Milk Research Council, Inc. Milk Dealer, *28:* 6, 43, 66–70, March, 1939.

The author calls attention to the charges of monopoly and excessive profits to which the dairy industry has been subjected since 1933. To counteract the effect of this propaganda he suggests that the story of the dairy industry since its infancy should be told to the public and that the benefits and protection that the industry has brought to the consumers should be publicized. C.J.B.

358. Value of Medical, Physical Examination of Dairy Employees. THOMAS A. SCOTT, Pres., Richmond Dairy Co., Richmond, Va. Milk Dealer, *28:* 7, 68–73, April, 1939.

Physical examinations in the milk industry are justified for the following purposes:

1. To select new workers and place them at a type of work for which they are fitted, physically, and mentally.

2. To inform the examining physician with respect to the physical condition of the employee so that he may advise measures for its improvement. Any knowledge gained in this way should be held in strict confidence between the doctor, his assistant, and the individual patient.

3. To inform the employer as to when and where conditions exist in the occupational environment which are apparently causing ill health, or are liable to cause it, that he may take measures for correction or control.

4. To protect those already employed from the risk of communicable diseases, such as tuberculosis and various other infections, which may be introduced into their midst by new applicants.

The author also sets forth several suggestions to follow in instituting plans for periodic examinations. C.J.B.

PHYSIOLOGY

359. The Racial Factor in the Pigeon Crop-sac Method of Bioassay of Prolactin. ROBERT W. BATES, OSCAR RIDDLE AND ERNEST L. LAHR, Carnegie Institution of Washington, Station for Experimental Evolution, Cold Springs Harbor, New York. Am. J. Physiol., *125:* 4, 722. 1939.

Different races and strains of doves and pigeons may differ markedly in the response (increased weight) of their crop-sacs to prolactin when this harmone is injected either intramuscularly or subcutaneously. When the crop-sac responses obtained are expressed in terms of prolactin units an extreme variation of five-fold was found among six races of pigeons and of eight-fold among fourteen strains of doves. These variations were still more extreme when a high dosage of prolactin was employed. D.L.E.

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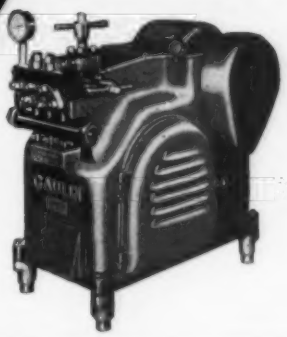

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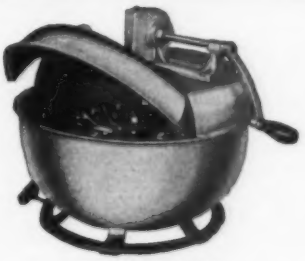
JALCO MOTOR COMPANY
UNION CITY, INDIANA



4 to 36 bottle
TESTERS

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These media offer the most uniformly reliable and economical means for the enumeration of colon bacilli. The advantage of these media over most others lies in the use of Sodium Desoxycholate as sole bacteriostatic agent. Sodium Desoxycholate is a pure chemical and has a clear-cut inhibiting effect on the growth of Gram positive bacteria as compared to Gram negative bacteria. It thus has none of the disadvantages generally found in other bacteriostatic agents such as bile, bile salt mixtures, or dyes.

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MADE FROM BOURBON AND MEXICAN VANILLA BEAN, VANILLIN AND SUGAR
EXPERTLY BLENDED AND PROCESSED TO PRODUCE A DELIGHTFUL MELLOW MILD FLAVOR
DAVID MICHAEL & CO.
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★ The National Dairy Council is the educational and sales promotional organization of the dairy industry. The Council operates nationally through its central office in Chicago and locally through its more than thirty unit Councils in all parts of the United States.

The National Dairy Council program reaches every member of the family through the chief opinion-forming groups in all professional and educational fields. Such key groups as physicians, dentists, teachers, nurses, nutritionists, writers and public health workers are kept informed constantly of the dietary importance of all dairy products.

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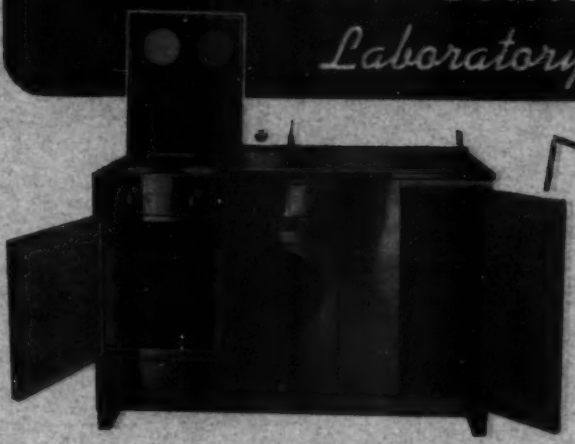
CP MILKONTROL

Multi-Service Laboratory Unit



- CONVENIENT
- COMPACT
- ATTRACTIVE
- ECONOMICAL

This unit, which is composed of a dry air sterilizing oven, a self-generating steam autoclave, an incubator and two hot plates, is ideal equipment for bacteriological control work in dairy and food products plants operating their own laboratories. It combines all essential bacteriological laboratory control equipment . . . . housing it compactly in a beautifully finished stainless steel cabinet that requires but 5′11″ x 2′2½″ floor space. May be readily fitted into any convenient location, as neither plumbing nor piping is required. Shelves, as shown in illustration, are adjustable for height. When hot plates are not in use, the hinged cover may be closed . . . providing additional working space.

For full details write for Bulletin T-684.

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Bacto-Tryptose Agar, prepared without the addition of selective dyes or other ingredients, supports luxuriant growth of all *Brucella* types. It is excellently suited for mass cultivation of these organisms for the preparation of bacterial vaccines or antigens.

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